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BULLETIN No. 112. DECEMBER, 1900.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

ORCHARD NOTES.

By

F. S. EARLE.

MONTGOMERY, ALABAMA.
THE BROWN PRINTING CO.
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ORCHARD NOTES.

The season of 1900 has been on the whole a favorable one for the orchardist. At Auburn the earliest blooming plums and peaches were killed by a sharp freeze on Feb. 18, when the thermometer dropped to 12°. The latest blooming plums like Wayland and Golden Beauty were injured by continued cold rains during the last of March that prevented pollination, causing the first nearly complete failure of the crop on these kinds in five years. The medium blooming plums and peaches set heavy crops notwithstanding a cold snap on March 17, when the thermometer dropped to 28°. It was 30° the morning of the 16th and had dropped to 32° by 9 p. m., so that the open flowers were exposed to a freezing temperature for at least ten hours. Many blossoms were killed but as stated, enough survived to make a very full crop. Unusually rainy weather during June and July caused serious loss from brown rot in peaches and plums, the falling of grape foilage from the attacks of downy mildew, and a more than usually heavy loss from summer rot of apples.

APPLES.

The condition of the new orchard (planted 1897-1900) continues to be very satisfactory. Our experience proves that it is entirely possible even on such thin drouthy land as ours to grow thoroughly thrifty, vigorous apple trees. Part of the land was seeded to hairy vetch in the Fall of 1898 and the remainder was seeded to vetch and oats in Oct., 1899. In March a strip three or four feet wide was plowed on each side of the row and was culti-

vated after every rain so as to keep a dust mulch about the trees. The middles were not plowed till the first of June in order to allow the vetch to ripen its seed so as to reseed the land. Frequent cultivations were continued till the middle of July when peas were broadcasted and cultivated in. The peas made a good growth during the late Summer and Fall and have been allowed to lie and rot on the ground. As the peas begun to die down the self-sown vetch seed began coming up and by spring the orchard will be a solid vetch field. The same treatment will be continued another year, plowing strips next the trees in March, allowing the vetch to stand in the middle till the seed is ripe and then cultivating the entire land thoroughly till middle of July and again broadcasting to peas. By this method two crops of rich leguminous vegetable matter are added to the soil each year so that it is rapidly gaining in fertility. The mechanical condition is already greatly ameliorated. Last Spring each tree was given two pounds of fertilizer consisting of a mixture of five parts each of cotton seed meal and acid phosphate to one part of muriate of potash. The soil is now so much improved and the trees are growing so rapidly that no more fertilizer will be required until the orchard comes in to heavy bearing.

The bearing orchard received the same treatment as the growing orchard except that each tree was given ten pounds of the mixed fertilizer and it was sprayed twice with Bordeaux mixture, once on April 13 and again on April 28. At the last spraying one-half pound of Paris green per barrel was added to the Bordeaux mixture. At the time of the first spraying many of the trees were in full bloom and a number of the flowers were killed, showing that it is not advisable to spray during the blooming season. The first spraying should have been done earlier but pressure of other work prevented. The

treatment served to lessen the number of wormy apples very noticeably and it held the rot in check till about the first of July. After that owing to continued rains it developed rapidly and finally destroyed a large proportion of the crop on many of the trees. Two or three additional later sprayings would probably have partially prevented this trouble but it seems doubtful if, in unfavorable seasons like the present, it would have entirely prevented it. This rotting of the fruit on the trees before maturity seems to be the most serious problem that confronts the apple grower in this latitude. It will probably have to be met by more frequent sprayings than are necessary at the North, and especially by the selection of resistant varieties. Among the kinds fruiting at the Station this year, the following were comparatively free from rot: Carter's Blue, Horse, Pine Stump, Red June, Steven's Winter, Thornton's Seedling, and Terry's Winter. Those noted as rotting very badly were American Golden Russet, Ben Davis, Elgin Pippin, Golden Pippin, Kittageskee, Oconee Greening, Romanite, Shannon Pippin, Summer Red and Winesap.

Apple Leaf Rust (*Roestelia*): Notes taken on Aug. 1, show the following varieties to be more or less effected by this disease.*

Carter's Blue, slightly.
Chattahooche, slightly.
Cooper's Red, moderately.
Dam, slightly.
Equinettelee, slightly.
Ey. Red Marguerite, badly.
Family, very badly.
Hames, slightly.
Horse, moderately.
Jonathon, very badly.

* For these notes and for other help in preparing this Bulletin, I am indebted to my assistant, Mr. C. F. Austin.

Mamma, slightly.
Red June, slightly.
Rhodes' Orange, slightly.
Rome Beauty, moderately.
Sabadka, slightly.
Santa, badly.
Senator, badly.
Shockley, moderately.
Texas Red, slightly.
Thornton's Seedling, slightly.
Wealthy, slightly.
Winesap, slightly.
Yahor, slightly.
Yopp' Favorite, slightly.

The following kinds were entirely free from rust: Aikin, American Summer, Apple of Commerce, Arkansas Black, Babbitt, Benoni, Ben Davis, Black Ben Davis, Bledsoe, Bradford, Buncomb, Champion, Carolina Greening, Cooper's Early, Duchess, Early Harvest, Elgin Pippin, Fall Pippin, Fanny, Grimes' Golden, Gravenstein, Hews' Crab, Jefferson Everbearing, Jennings, Julian, Kinnard's Choice, Limbertwig, Maiden's Blush, Mam. Black Twig, Mangum, Mavarack Sweet, Moultries, Oszi-vaj, Pear (or Palmer), Rawls' Janeton, Red Astrachan, Red Beitigheimer, Red Limbertwig, Saxon Priest, Sekula, Selymes, Shackleford, Summer Cheese, Summer King, Summer Queen, Sweet Bough, Taunton, Tuscaloosa, Yates, Yellow English, Yellow Horse, Yellow Transparent, York Imperial.

This agrees very well with last year's experience (See Bull. No. 106, p. 168) but American Summer and Moultries that showed rust last year escape, while fourteen kinds are affected this year that escaped last. A few of the Hungarian kinds are slightly affected this year for the first time, but in the main native American kinds

are more susceptible than foreign kinds. This is rather anomalous since the disease is indigenous, occurring freely on our wild crab apples.

Green Aphis of the Apple—In Bulletin No. 106 p. 166, it was noted that after being very abundant and troublesome the aphids suddenly disappeared during a period of heavy rains in August. The circumstances were such as to suggest that they had been carried off by some epidemic disease, but unfortunately no proof of this was secured. In any event the disappearance was so complete that in the Spring of 1900 the trees were almost clear of them and they have caused less damage than at any time in five years. Their numbers gradually increased so that by Fall they were again quite abundant but as the growing season was over they did comparatively little harm.

A new treatment was tried this season that proved much more satisfactory than the strong kerosene emulsion used last year, since it was equally effective in killing the insects and did no harm whatever to the foliage. Though home made decoctions of tobacco were unsatisfactory (See Bulletin 106, p. 164), the commercial product known as "Rose Leaf" proves to be by far the best insecticide yet tried for controlling this aphis. It is best used at a strength of one part to fourteen of water and should be applied as a very fine spray. Since it is impossible to reach all the lice at a single spraying on account of the shelter furnished by the crumpled leaves it is always best to spray two or three times at intervals of four or five days, since in that time those that escaped the first spraying will have moved out of their shelter seeking a fresher food supply. Three such sprayings within two weeks time should clear even badly infested

trees. Whether it will pay to go to this expense must be determined by the condition of the trees and the abundance of the lice.

It was hoped that spraying the trees with crude petroleum in winter might destroy the eggs of this insect. On March 12, a number of young trees that had been badly infested the year before were thoroughly sprayed with crude petroleum taking pains to direct the spray against the ends of the twigs where the eggs are usually deposited. The buds were still quite dormant. No injury resulted to the trees. The effect on the lice, if any, was obscured by the general scarcity of them during the early part of the season. By the first week in May a few lice could be found on each of these treated trees though none of them were badly infested. It was much later than this before they became numerous in any part of the orchard, so the treatment seems to have had no result so far as the aphids are concerned.

The question of varietal resistance to this pest is still an open one but as was noted last year, kinds with thick, hairy twigs seem to be less infested than those in which the young twigs are slender and comparatively smooth. Notes taken on Aug. 1, show the following kinds to have been more or less infested with aphis:

Apple of Commerce, badly.
Bledsoe, badly.
Chattahooche, slightly.
Jennings, badly.
Mamma, moderately.
Maverack Sweet, moderately.
Oszi-vaj, moderately.
Pear (or Palmer), moderately.
Red Beitigheimer, moderately.
Rhodes Orange, badly.
Summer Queen, badly.
Sweet Bough, moderately.
Tuscaloosa, badly.
Yellow English, badly.

By Nov. 1, the following additional kinds were more or less infested; Black Ben Davis, Bradford, Buncomb, Carolina Greening, Carter's Blue, Early Harvest, Equinettelee, Family, Fall Pippin, Gravenstein, Hominy, Jeffries, Limbertwig, Magnum, Mam. B ack Twig, Moultries, Nickajack, Pasman, Rawl's Janeton, Santa, Senator, Shackleford, Shockley, Summer Cheese, Tull, Winesap, Yakor, Yates, Yopp's Favorite. Of these kinds 21 have smoothish twigs, 16 are medium, and 10 rather hairy. Of the kinds not infested with aphids, 8 have smoothish twigs, 18 medium and 28 hairy twigs.

This list does not coincide very closely with that given last year, showing that infestation or immunity is in part at least accidental.

A List of Hardy varieties.—The following kinds have been entirely free from rust, aphis and leaf spot and have made a perfectly satisfactory growth both in 1899 and 1900. Aiken, Babbitt, Hyari Piros, Magyur, Maiden's Blush, Metel, Ponyike and York Imperial. It is interesting to note that of these eight kinds four are among the new Hungarian varieties sent out by the Department of Agriculture that have not yet fruited in this country. Of the other kinds in last years' select list, Arkansas Black, Duchess, Fanny, Haywood, Milalyfi, and Thornton's Seedling lost some foliage from leaf spot late in the season, while Carolina Greening was slightly attacked by aphis, and Hames developed a little rust. Among the kinds not included in the above list that are in very satisfactory condition this Fall may be mentioned Battvani, Benoni, Bledsoe, Buda Summer, Carter's Blue, Champion, Elgin Pippin, Hames, Herschal, Cox, Horse, Julian, Keskemet, Kinnard's Choice, Limbertwig, Red Astrachan, Red June, Saxon Priest, Summer Wafer, Texas Red and Yellow Transparent.

Promising New or Little Known Varieties. For the

last three years an effort has been made to secure trees or grafting wood of all promising local seedlings in the hope of finding kinds better suited to our conditions than those now in general cultivation. A number of such kinds have been secured and the Station earnestly request all who are interested in apple growing in this State to co-operate by reporting any promising kinds that may come to their notice.

Among little known kinds deserving of special mention are the Hackworth and Herschal Cox. The Hackworth originated in North Alabama and has been grown there locally for twenty or thirty years. It is a vigorous, erect growing tree with large, healthy leaves. The fruit ripens in August. It is large subconic yellowish white, heavily striped with red. It seems to be free from rot and to be a very desirable late Summer apple. Herschal Cox is of the Romanite type, small and not of the best quality, but the latest keeper we have in North Alabama, surpassing even the Shockley in this respect. The tree is a better grower than Shockley and it should perhaps replace that variety for general planting.

Revised List of Apples for General Planting in Alabama:—The following list named in the order of ripening will give a good succession of fruit from the first of June till early winter. Yellow Transparent, Early Harvest, Red June, Red Astrachan, Horse, Hackworth, Carter's Blue, Thornton's Seedling, Kinnards Choice, York Imperial, Yates, Shockley, Herschal Cox. Unfortunately few, or perhaps none, of the above are fully satisfactory under our conditions and it is hoped that in the future better kinds may be substituted for them. Yellow Transparent is a poor grower and the foliage is somewhat subject to leaf spot. It is an abundant and early bearer and the handsome yellow fruit is free from scab and rot. For market it is the most promising of

the very early kinds. Early Harvest is rather better quality than the above and is nearly as early. It is to be preferred for home use. The tree is a fairly good grower but often suffers severely from aphids, and it is not free from leaf spot. Red June is a strong growing thrifty tree but unfortunately late in coming in to bearing and subject to rust. The fruit ripens through a long season and it is one of the most desirable for family use. On young trees and with good care and cultivation it is a fine market apple but with age and neglect it is too small for market. It should be in every family orchard. Red Astrachan is a vigorous, healthy, strong growing tree that comes early into bearing. The fruit is large and showy but too acid to suit most tastes, and is inclined to rot badly. Where this trouble can be controlled it is one of the most profitable of the early market apples. At Auburn it begins ripening about June 10 though some specimens can be gathered earlier. It does not all ripen at once like the Yellow Transparent but the trees need to be picked over several times. The Horse is a well known kind doing well in all parts of the South. The tree is healthv and a free grower. The large greenish yellow fruits are too sour for eating out of hand but are excellent for cooking. At Auburn it begins ripening early in July. The Hackworth has been mentioned on a previous page. It is unknown outside of Alabama, but seems very promising here. It ripens through a long season beginning the last of July and continuing throughout August. The tree is very thrifty and the large handsome fruits are of good quality and attractive. It is recommended for both home use and market. Carter's Blue is also an August apple, but averages a little later than Hackworth. It is a large green apple with dull red stripes and a heavy white bloom. It does not rot badly. The tree is healthy and a vigorous grower.

It is one of the few kinds that succeeds well at the far South. Thornton's Seedling is a good sized greenish apple with red stripes ripening in September. It is of good quality and its comparative immunity from rot marks it as valuable for an apple ripening at this season. The tree is healthy and productive. Kinnard's Choice has not been fruited at the Station but in North Alabama it is one of the most satisfactory kinds for late Fall and early Winter. The trees in the young orchard here are remarkably strong and healthy. York Imperial has also not been fruited here but it has made a good record in North Alabama and it is one of the few kinds in the young orchard that have been spotless and free from enemies of all kinds during the last two seasons. It is confidently expected that this will prove one of our very best late market apples. Yates is a favorite apple with many growers especially in Chambers, Tuscaloosa and Clay Counties. It is a good keeper and of the best quality but is too small for general market purposes. The tree is only a medium grower and is subject to leaf spot and to injury from green aphis. Shockley; this well known kind is valued chiefly for its keeping qualities. The apple is small and of rather poor quality and the tree is apt to be rather short lived. It is attacked badly by both rust and aphis and is only retained in the list for the want of something better that will keep as long. Herschal Cox is included here with some doubt. It is a better tree than Shockley but the fruit is about equally poor. However it keeps perfectly all winter in North Alabama which is a point of prime importance. It has not been fruited here.

It will be noted that Ben Davis Winesap and Limbertwig have been omitted from the above list although included in the list given in Bulletin 98, p. 265. It is

thought that Kinnard's Choice and York Imperial will fully take their places and be better suited to our conditions.

As a result of several years observation and study it seems prudent to strongly urge the increased planting of apples in Middle and Northern Alabama. It must be fully understood, however, that apples will succeed here only with the best and most intelligent care and cultivation.

FIGS.

The following eleven kinds fruited on the Station grounds this season:

Adriatic. Large, yellowish white, flesh light red, late, beginning to ripen middle of August and continuing till frost; tree vigorous, fairly hardy, starting rather late in Spring. While not as sweet as Celeste it is pleasant in flavor and its large size makes it very attractive. It should be more widely planted.

Black Ischia. Large roundish, shinning black, flesh deep red, season last of August. Of no special value.

Brown Turkey. Small, light brownish, sweet, ripening during a long season. A fairly good fig but not equal to Celeste. With us the tree is feeble and a poor grower.

Brunswick. Large, pyriform, greenish yellow, nearly overspread with dark brown, flesh reddish brown, rich, season middle of August till frost, tree fairly vigorous and productive. With us this year the last of the crop did not ripen well. Not fully satisfactory.

Celeste (or Celestial). Small, pyriform, light brown, often with purplish tinge, flesh reddish, soft, very sweet, season July, tree thrifty, very hardy, starts early in Spring. This is by all odds our best early fig and the one in most general cultivation. On vigorous trees it

often sets a small late crop but these late fruits are inferior and many of them fail to ripen.

DuRoy. Small, much like an inferior Celeste. This much advertised kind has nothing to recommend it. Our trees were from Mr. Normand, the introducer.

Green Ischia. Medium size, rounded, yellowish green, skin thin, flesh deep rich red, sweet, high flavor, tree thrifty, fairly hardy, very productive, season last of August till frost. This is our best and most reliable late fig and should be widely planted. It does not begin ripening till the main crop of Celeste is entirely over.

Madeline. Large, light yellow, flesh yellowish white, rather soft, sweet, rich, reason last of July and August, trees fairly vigorous and productive. This is a good fig and is valuable as ripening between Celeste and Green Ischia.

New French. Small, rounded, white, of medium quality, rather firm, tree a fairly good grower. It will take farther experience to decide whether or not this kind has any special merit.

White Nerii. Large, roundish, greenish yellow, flesh reddish, rather soft, good quality, begins ripening middle of August, tree feeble, not very productive.

White Smyrna. Medium and large, somewhat flattened, greenish white, overspread with a tinge of brown, flesh light red, firm, sweet, rich, season middle of August till frost, tree only moderate grower but fairly productive. This is a good fig and keeps remarkably well after picking.

Recommended for General Planting: Celeste, Green Ischia, Adriatic, White Smyrna and Madeline.

KAKI (JAPANESE PERSIMMON).

As was noted in Bulletin 106, p. 171, the freeze of February, 1899, killed these trees all to the ground. Part were killed outright and part sprouted from the crown. The following kinds were sufficiently recovered to bear some fruits this season: Tabors No. 23, Tabors No. 72, Tabors No. 129, Tane Nashi, Yeddo Ichi.

This fruit is well adapted to the conditions in South Alabama and should be more generally planted in that region. The trees often begin bearing the year after they are planted and the crop is a very sure one. The fruits are large and handsome. Though too rich for some tastes most people are fond of them and they are gradually winning a place in the large markets.

ORANGES.

Mr. H. J. Webber of the Department of Agriculture, Washington, has succeeded in making a number of hybreds between the cultivated sweet oranges and the hardy, deciduous hedge orange, *Citrus trifoliata.* His hope, of course, is to find among them some kinds that will combine the hardness of the one parent with the desirable fruit of the other. As these interesting productions have not yet reached bearing age it is impossible to foretell the result. Wishing to test their hardiness in this latitude the Department sent trees of fifty-one of these hybreds to this Station last Spring. They have nearly all made a very vigorous growth during the Summer but at this writing (Jan. 3) there has been no cold sufficient to test their hardiness. It is interesting to note that of these kinds three have died, thirty have small trifoliate, deciduous leaves like the hedge orange, only nine have large simple, evergreen leaves like the

sweet oranges, while nine have larger, variously modified trifoliate leaves that are evergreen. Their continued behavior will be watched with great interest.

PEACHES.

The co-operative experiment orchard planted in 1898 bloomed abundantly but for some reason set a very light crop. The few older trees planted in 1896 bore heavily but the fruit rotted very badly on account of continued wet weather during the ripening season. Owing to the exceptional character of the season, it is thought best not to express an opinion as to the merits of the different varieties at this time. Notes on the season of blooming are given below. This subject is not as important with peaches as it is with plums as all the varieties are supposed to be self-fertile, but since a difference of even a very few days in the blooming period may decide the safety or loss of the crop from cold it is a matter worthy of consideration.

Notes on the blooming of peaches in 1900.

Varieties.	Feb. 18. Thermometer 12°.	March 6.	March 10.	March 14.	March 17. Thermometer 28°.	March 25.
Matthews' Beauty..	....	....	buds pink......	first blooms....	....	full bloom .....
McKinney	Buds of all varieties slightly swollen except as noted below.		nearly dormant.	buds pink......	Over half the open flowers killed except as noted. When petals have fallen they are killed as badly as the freshly open flowers. No unopened buds killed. No striking difference in the different varieties or races.	first bloom.....
Marks.........			nearly dormant.	buds pink......		full bloom.....
Ovido		first blooms. ...	nearly full bloom	full bloom and falling.....		mostly fallen.
Gray...............			buds pink......	first blooms ..		past full b oom.
Reeves			buds swollen .	first blooms ..		full bloom.....
Carmen			buds swollen.	first blooms ...		full bloom.....
Chinese Cling .			buds swollen, some pink......	first blooms		full bloom....
Elberta.			buds pink	first blooms		past full bloom.
Mamie Ross.........			buds pink	first blooms....		full bloom.. ..
Pallas			buds pink......	first blooms		full bloom......
Tabor			buds pink.....	blooming.... ..		full bloom......
Honey..............	much swollen, not show'g pink	first blooms....	nearly full bloom...	full bloom.....		mostly fallen...

Notes on the blooming of peaches in 1900.

Varieties.	Feb. 18. Thermometer 12°.	March 6.	March 10.	March 14.	March 17.	March 25.
Peento	full bloom		leaves 1 in. long			
Angel	first blooms	blooming	full bloom, ¼ crop left	bloom falling		leaves half grown
Waldow	first blooms	blooming	full bloom, nearly full crop	bloom falling		leaves half
Old Mixon Free			buds swollen	first blooms		full bloom
Mt. Rose			buds swollen	first blooms		full bloom
Alexander			nearly dormant	buds hardly pink		first blooms
Onderdonk		first blooms	blooming	blooming		past full bloom
Cobler's Indian			buds pink	first blooms		full bloom
Imperial			first blooms	full bloom		past full bloom
Victoria			first blooms	blooming		full bloom
Triumph			buds swollen	buds pink		nearly full bloom
Sneed			buds pink	first blooms		nearly full bloom
Old Orchard—Lady Ingold			swollen, some pink	first bloom	buds ⅓ open. flowers 50 % k'd	

Notes on the blooming of peaches in 1900.

Varieties.	Feb. 18, Thermometer 12°.	March 6.	March 10.	March 14.	March 17.	March 25.
Tillottson	....	....	swollen, some pink.	first blooms	buds ¼ open. flow's 10-20% k'd	....
Early Crawford	....	....	swollen, some pink	first blooms	1% open, flowers half killed	....
Hale's Early	....	....	buds swollen.	buds hardly pink	none opened. none killed	....
Mt. Rose	....	....	swollen, some pink	first blooms	buds ¼ open, flowers 40 % k'd	....
Alexander	....	....	nearly dormant	buds hardly pink	none open, none killed	....
Stump	....	....	swollen, some pink	first blooms	very few open, 40-50 % killed	....
Elberta	....	....	swollen, some pink	blooming	buds ¼ open, flow's 20-40% k'd	....

Classified according to the season of blooming we have the following:

Earliest Blooming:—Peento, Angel, Waldow, all of the Peento type.

Very Early Blooming:—Ovido, Honey, Onderdonk, of the Honey and Spanish types.

Early Blooming:—Imperial, Victoria; Spanish type.

Medium Blooming:—Matthews Beauty, Gray, Reeves, Carmen, Chinese Cling, Elberta, Mamie Ross, Pallas, Tabor, Old Mixon Free, Mt. Rose, Coblers Indian, Sneed, Lady Ingold, Tillottson, Ey. Crawford, Stump; including all of the North China type, most of the Persian and representatives of the Spanish and Honey types..

Late Blooming:—McKinney, Marks, Triumph, all Persian.

Very Late Blooming:—Alexander, Hales Early, both Persian.

The varieties of the Peento race all bloom so early as to be practically worthless for planting in any part of this State. They are the best peaches for the orange belt but should not be planted much farther North. Some at least of the varieties of the Honey and Spanish types bloom late enough to be comparatively safe and there is no question but what in South Alabama the trees will be found thriftier and better adapted to the soil and climate than most varieties of the North China and Persian types. Unfortunately as yet we have no varieties among them fine enough to compete in market with Elbertas and Crawfords and none as early as Alexander. A race of peaches combining the thriftiness and fruitfullness of the Honey with the late blooming of Alexander and the fine market qualities of the Elberta would indeed be a boon to the Southern fruit grower. Such a combination of characters is not beyond posibility to the skillful plant breeder and our originators of

new varieties should set themselves the task of producing it.

PEARS.

Kieffer pears in the old orchard bore a heavy crop, while the LeContes made less than half a crop. Only a portion of the trees in the new orchard fruited.

In Bull. 106, p. 173, it was noted that one result of the February freeze (1899), which killed all the bloom buds was almost complete immunity from blight during that season. This immunity was so complete that the disease seemed to have entirely disappeared from the Station orchard. This Spring the Kieffers and LeContes although blooming very heavily were entirely free from blight. A few Bartlett trees blooming two or three weeks later received the contagion from some source and nearly all the flower clusters developed the blight so virulently that notwithstanding repeated prunings the trees were nearly killed before it could be checked. These blighting Bartletts caused a few "growing tip" infections in the Kieffers and caused the blighting of some clusters of apple blossoms.

PLUMS.

Most of the varieties of plums in the Station orchard bore a full crop this year and it is now possible to form an estimate as to their value for this region. Some light has also been obtained on the vexed question of the nomenclature of the Japanese varieties. The trees for this orchard were obtained from a number of prominent nurseries in different parts of the West and South and in Bulls. 98 and 106 the names under which they were purchased were used in all cases. It now appears that as represented here (trees purchased in Jan. 1896), the following are all Abundance:

Botan from T. V. Munson & Son, Denison, Tex.

Yellow Fleshed Botan, P. J. Berckmans Co., Augusta, Ga.

Berger, from Stark Bros., Louisiana, Mo.

The following while differing slightly among themselves are for all practical purposes the same as Chabot. This kind like Abundance is quite variable and seems to be represented by more or less distinct strains.

Babcock, from G. L. Tabor.
Baileys Japan, from G. L. Tabor.
Hattankio, from T. V. Munson & Son.
Munson, from P. J. Berckmans Co.
Yellow Japan, from G. L. Tabor.

Red Nagate, from G. L. Tabor seems to be the same as Red June from Stark Bros; and Botan of Tabor is the Berckmans.

As plums are now usually classified our varieties belong to five different races or types, the Japanese and four natives. These are the Americana type, the Wild Goose type, the Wayland type and the Chicasaw type. The domestica type which includes the European plums and prunes does not succeed here and none were planted.

The Americana Plums: The plums of this type have been developed from the wild plum of the North and East. They are useful for planting at the far North on account of their great hardiness to cold but they are not at home here. So far as we have tried them the trees are poor growers, very short lived and unproductive.

At present they are represented in the orchard only by Hawkeye and Rockford though several other kinds were planted that have since died. Although blooming very late long after danger from frost is over, they bore no fruit at all this season. The planting of varieties of this type is not advised for this State.

The Wild Goose Plums: The ancestry of this group of plums is still a matter of doubt. Some authorities have supposed them to be hybreds between the Americanas and Chicasaws but there is no proof of this theory except their somewhat intermediate characters, and on the whole it seems more probable that they are descended from some of the Southern wild plums. The native plums of our Southern woods have been strangely neglected by botanists and as yet we have very little knowledge of their number or relationships. It is certain that in the red clay soil of the granitic hills north of Auburn, a wild plum occurs abundantly that has all the characteristics of this group of cultivated kinds. Botanists to whom specimens of it have been submitted unite in pronouncing it *Prunns hortulana,* the supposed bybred parent of the Wild Goose plums, but there is no conceivable reason for supposing that this commonly occurring native plum is a hybred. It has so far been impossible to determine its true botanical position.

Before the introduction of the Japanese kinds this race of plums was our chief dependence at the South for market sorts. While they have been largely supplanted in popular favor by these new introductions they have some very good qualities and should not be overlooked in planting for home use and local markets. For distant shipment they are doubtless inferior to the best of the Japs, still they are likely to long continue to hold a recognized place in the market. As a rule they bloom rather late so as to be comparatively free from injury from frost. They succeed admirably in Middle and North Alabama, but are not so well adapted to the coast region. The following kinds are in the Station orchard:
Charles Downing.—This is a medium sized plum of very fine quality, fairly productive, late, ripening July 10 and a very late bloomer. Unfortunately the tree is rather

a feeble grower and it does not seem quite at home. It would succeed better farther North. It is worth planting for home use on account of its fine quality and because it extends the season for this class of plums.

Milton: This is a fine plum blooming a day or two later and ripening three or four days earlier than the Wild Goose. This season the first picking was on June 9. It is an oblong plum, darker, richer red than Wild Goose and marked with large white dots. The flesh is firmer and it hangs on the tree better than the Wild Goose. It is clearly superior to that well known kind and is, every thing considered, the best variety of its class that we have tested. It was one of the very few kinds carrying a full crop in 1899.

President Wilder: This is a high flavored, medium sized red plum, ripening late in June. It does not seem to be very productive and like Charles Downing would probably do better farther North. It can not be recommended here except, perhaps, to keep up a succession and fill the gap between Wild Goose and Charles Downing.

Whitaker: This is much like Wild Goose and ripens at about the same season, possibly averaging two or three days later. It is hardy and productive, bearing a full crop in 1899 and also this season, but it is so much like Wild Goose that there is no need to plant both kinds. It will take farther experience to decide which of the two is preferable.

Wild Goose: Too well known to require extended comment. It succeeds well in Central and North Alabama and is very prolific when planted near other kinds. It requires cross pollination and does not bear well if planted by itself. It begins ripening here early in June in ordinary seasons and continues in season for nearly three weeks. It failed to bear in 1899 though others of this class carried a full crop.

Wooten: A small oblong red plum, ripening ten days later than Wild Goose. It has little to recommend it except hardiness and productiveness as the quality is poor. It ripened a full crop in 1899.

The Wayland Plums: These resemble the Wild Goose type somewhat closely but they bloom later and ripen decidedly later than most of those kinds and seem adapted to a range of country a little farther South. What wild species they are descended from is uncertain. They cannot be recommended for shipment but are desirable for the home orchard on account of the sureness of the crop, an entire failure being almost unknown, and because of their late ripening which will prolong the plum season till the first of September. In quality they are not equal to the best kinds of the Wild Goose type, but they are useful for canning, jellies and preserves. They are represented in the Station orchard by two kinds, Wayland and Golden Beauty. The former is bright cherry red, and rather milder in flavor and is probably preferable where only one is to be planted but the Golden Beauty is very prolific and it is a few days later. Both kinds ripen in August, often lasting to early September. The crop was lighter this year than it has been in five years owing to heavy and continued rains during the blooming season that prevented pollintion. A failure from Spring frosts is almost or quite unknown.

The Chicasaw Plums: The varieties of this type in cultivation are simply selections from the best of our native "old field" plums and have little to recommend them for general planting. They mostly bloom so early as to be in great danger from Spring frosts and they are too soft and small to be of much value for shipment. A few trees of the earliest kinds may be useful in the home garded as they ripen before the other kinds. They are

represented in the Station orchard by the following three kinds:—Emerson: A small red plum, very early but of no great value. This season the crop all rotted when half grown. Lone Star: Much like Emerson of no value. Transparent: A medium sized yellow plum of nice sweet, delicate flavor. It is the best of the lot bupt cracks badly in wet weather.

The Japanese Plums: This is by far the most important type of plum for this region. For commercial orchards they are second in value only to peaches and with properly selected varieties the crop is surer than peaches, being less liable to injury from Spring frosts and from rot. There has been much confusion in regard to the names of the varieties and as noted on page 175, several of the supposed kinds in the Station orchard prove to be identical. The following sixteen kinds seem to be sufficiently distinct. They are mentioned in alphabetical order.

Abundance (this equals Botan of some, Yellow fleshed Botan, and in our orchard Berger): This is the best known and most widely planted of any of the Japanese plums. It blooms with peaches but usually holds a number of buds in reserve that open if the first blooming is killed so that an entire failure of the crop is rare. It is a handsome red plum with clear transparent skin that is yellow under the red, of very fine sweet flavor, the flesh becoming soft and juicy when fully ripe. Picked when still firm it ships well. It began ripening this year the middle of June and lasted two weeks. It it usually free from rot. Perhaps its greatest fault is a tendency to overbear, making it necessary to thin freely to secure good sized fruit. It is the best plum of its season and is strongly recommended for general planting.

Berckmans (Botan of some): This is another large

red plum very similar to Abundance in tree and fruit. It was formerly confused with it under the name of Botan. The color is a little duller, being underlaid with green instead of yellow, the size averages a little larger, but the quality is not so good. It ripens at about the same season. It is a plum of some merit but not so good as Abundance.

Burbank: This contests with Abundance for the first place in popularity as a market plum. It is a little larger and even richer in color, has firm, high flavored flesh and ripens an average of a week to ten days later than Abundance, although occasional specimens ripen nearly as early as that kind. The tree is thrifty with a spreading habit of growth quite different from that of most of the Japanese plums. Like Abundance it is a great bearer and needs heavy thinning. In some seasons it rots badly which is its only fault. It is recommended for general planting.

Blood plum No. 4: This is of the Satsuma type but inferior to that kind. It is not worth planting.

Chabot (Babcock, Bailey, Hattankio, Munson and Yellow Japan of our orchard belong here): This is a large red plum with yellow under-color. It is late, ripening here about July 10. It is a good shipper, having firm flesh of fairly good quality and it is usually free from rot. The tree is a good grower. It is recommended for general planting though possibly it should be replaced by Orient.

Hale: Young, only two years planted, but they did not fruit well this season. The few fruits secured were rather disappointing. Final judgment will have to be suspended.

Kelsey: This is the largest and in some respects the finest of the Japanese plums but it has two such serious faults that its planting cannot be advised in this State.

It blooms so early that the crop is usually killed, and it rots very badly. Its season is late, middle to last of July.

Kerr: This is a remarkably good plum whose valuable qualities seem to have been overlooked by nursery men and orchardists. It is the earliest of our really good plums ripening here about the first of June. It is large, rich yellow, with firm flesh of high quality. It blooms rather late and the tree is a good grower. It is strongly recommended for both home use and market.

Long Fruited: This is a small red plum with very firm flesh. It ripens a few days earlier than Kerr. The tree with us has not been thrifty. The quality is fairly good but the size is too small for market.

Maru: This is a red plum about the size of Abundance and ripening a few days later. The quality is poor and it rots very badly. It is not worth planting.

Normand: This is a large yellow plum of good quality, ripening the last of June or first of July, between Burbank and Chabot. Its color is somewhat against it for market, but it is useful in filling the gap between these two kinds, and it is in every way worthy of planting.

Orient: This is very much like Chabot but it seems to be distinct, and to be an improvement on that kind, being brighter colored, slightly larger and two or three days earlier. It is strongly recommended especially for market planting.

Red June (Red Nagate of some): This is a very showy, handsome red plum ripening at least a week earlier than Abundance. It is a good shipper and very free from rot. It is not as good in quality as the Abundance but it combines more desirable qualities for a market plum than any of the others. It blooms late and the tree is vigorous and productive.

Satsuma: This is a large plum with dull red mottled skin but bright blood red flesh. When fully ripe the quality is very fine. It cannot be recommended for market on account of its early blooming habit which makes the crop too uncertain, but it should be included in plantings for home use on account of its superior quality especially when cooked. It is one of the finest fruits grown for canning and for jelly on account of its brilliant color and peculiarly rich, pleasant flavor. It ripens about the first of July.

Willard: This plum has nothing to recommend it but earliness. With us it is no earlier than Kerr and not nearly as good. The tree here is a poor grower and unproductive.

Yosebe: This is the earliest Japanese plum we have tested, ripening a few days earlier than Keer and slightly in advance of Longfruited. It is a small bright red plum with firm flesh, free from rot and of very fair quality. The tree blooms late and is thrifty and productive. It is probably too small for a profitable market fruit, yet its earliness, high color and other good qualities make it at least worth a farther trial.

Hybred Plums: The following kinds are hybreds between the Japanese plums and some of the other races. While they are very interesting and suggest great possibilities for future improvement it cannot be said that any of them fully come up to the standard for a market plum.

Golden (Gold of Stark Bros.): This is a hybred between the Japanese and the Chicasaw plums. It turns golden yellow long before it is ripe and the loaded trees are very showy and beautiful. When ripe it is a light bright red at least on the side toward the sun. The quality is poor and watery, and this season much of the crop was lost through sunburn and rot. On the whole it is a disappointment.

Excelsior: Said to be a hybred between the Japanese and Wild Goose races. It is a good sized, early, dull red plum of better quality than Golden. The tree is a fine grower and very productive. It is said to do well at the far South. It is perhaps worthy of farther trial. The Wild Goose characteristics seem to predominate in the fruit of this plum as the Chicasaw does in that of Golden.

Wickson: A hybred between Kelsey and *Prunus Simmoni*, which latter parent the tree greatly resembles. This is truly a magnificent plum, larger and handsomer than any of those mentioned above. Its one great fault is that it blooms too early for safety. It ripens about the first of July, but this year there were only two or three specimens to the tree. In fact we have never secured a full crop from it.

Lists of Plums for General Planting in Alabama. As a short list including only the very best plums for market we suggest the following mentioned in the order of ripening. They will cover the period from the first of June to the middle of July with a short break about the first of July. Kerr, Red June, Abundance, Burbank, and Orient. A large orchard of these five plums, if properly managed, could hardly fail to be profitable. Abundance and Burbank bloom together and should be planted near each other in order to secure cross pollination, while Kerr, Red June and Orient all bloom about together but a few days later. For a longer list add Yosebe for very early, Berckmans, Normand and Chabot.

For a full list for home use and local market, plant all of the above and add Transparent, Milton, Wild Goose, Satsuma, Wickson, Wayland and Golden Beauty.

The Blooming Season of Plums: As has been noted in previous Bulletins the blooming season of plums is especially import since many, or perhaps most, of the

varieties are infertile to their own pollen and require cross pollination in order to bear fruit. For this reason plums should not be planted in large blocks of one variety but rows of one kind should be alternated with rows of one or more others, taking care to mate together kinds that bloom at approximately the same season. The notes given below on the blooming season for 1900 show a rather close agreement in the sequence of varieties with observations recorded for other seasons at this place, indicating that there is but little variation in this respect from year to year, although the actual season of blooming varies quite widely in different seasons. The sequence observed here however is not the same that is recorded for the same varieties in more northern localities, (see particularly the Vermont Bulletins and Reports). It is hard to see what should cause this difference in the comparative behavior of varieties in the two sections.

Notes on the blooming of plums in 1900.

	March 6.	March 10.	March 14.	March 25.	March 29.	April 6.
Abundance		buds white	full bloom	Mostly fallen		
Babcock*		buds separated	full bloom	falling		
Bailey*		buds separated	full bloom	falling		
Berckmans		buds white	full bloom	falling		
Berger †		buds white	full bloom	mostly fallen		
Blood No. 4	first blooms	nearly full bloom	flowers falling	fallen		
Potan (Tabor) ‡		buds white	full bloom	falling		
Botan (Munson) †		buds white	full bloom	mostly fallen		
Burbank		first blooms	blooming	falling		
Chabot		buds separated	blooming	falling		
Chas. Downing		nearly dormant	buds separating	buds separated	first blooms	full bloom
Earliest of all		dormant	nearly dormant	first blooms	nearly full bloom	
Emerson	first blooms	full bloom	falling	fallen, fruits setting		
Excelsior		first blooms	full bloom falling	fallen		

Golden—(Gold)	....	buds separated.	blooming......	mostly fallen...	....	....
Golden Beauty.....	.... ..	dormant........	buds separating	buds separated.	buds white..	blooming......
Hale...............	....	first blooms....	nearly full bloom.	mostly fallen ..	....	....
Hattankio*...	....	buds separated	blooming ...	mostly fallen .	....	....
Hawkeye	....	dormant.	dormant	dormant	dormant ...	nearly dormant....
Kelsey..............	first bloom badly killed in Feb.	nearly full bloom......	nearly full bloom........	fallen.........	....	....
Kerr	....	buds separated	nearly full bloom ...	full bloom	....	....
Lone Star . .	....	buds white ...	full bloom......	fallen...	....	....
Long fruited......	....	dormant .	dormant.......	first blooms many buds still dormant	first blooms ..	full bloom .. .
Maru...............	....	dormant	dormant...... .	nearly dormant...	first blooms, most buds not separat'd	nearly full bloom ....
Milton	....	nearly dormant ...	buds separating	first blooms....	full bloom .. .	....
Munson *	....	buds separated.	blooming.	....	....	....
Normand	....	buds white.....	full bloom .	falling	....	....
Orient	....	buds separa'ed.	first blooms ...	mostly fallen..	....	....
Pres. Wilder.... ..	....	nearly dormant.. .	buds separating	first blooms....	blooming.. ..	full bloom .. .
Red nagate	....	nearly dormant ..	buds white....	full bloom.	full bloom .. .	first blooms ..

Notes on the blooming of plums in 1900.—Con'd.

	March 6.	March 10.	March 14.	March 25.	March 29.	April 6.
Rockford	dormant	dormant	dormant	dormant	nearly dormant	first blooms
Satsuma	first blooms badly killed in Feb.	nearly full bloom	full bloom and falling	leaves half grown		
Transparent		buds separated	first blooms	mostly fallen		
Wayland		buds separated	buds separated	first blooms	first blooms	full bloom
Whitaker		buds separating	buds separated	nearly full bloom	full bloom	
Wickson	first blooms badly killed in Feb.		full bloom	fallen		
Wild Chicasaw	first blooms	nearly full bloom	full bloom and falling			
Wild Goose		buds separating	buds separated	nearly full bloom	full bloom	
Willard		nearly dormant	nearly dormant	nearly dormant	first blooms	blooming
Wooten		buds separating	buds separated	nearly full bloom	full bloom	
Yellow Botan †		buds white	nearly full bloom	falling		
Yellow Japan *		buds separated	blooming	falling		
Yosebe		dormant	dormant	first blooms, most buds not separ'ted	first blooms	nearly full bloom

* Equals Chabot.
† Equals Abundance.
‡ Equals Berckmans.

SAN JOSE SCALE.

In Bulletin 106 it was noted that in the plum orchard planted in 1896 two trees proved to be infested with scale, and that from this center of infection it was slowly spreading to other trees in the orchard. At the close of the growing season of 1899 it had developed sufficiently to conspicuously whiten large areas on the trunk and larger branches. It had not spread to the twigs and smaller branches and it had so far interfered but little with the growth and vigor of the trees. During February, 1900, this entire orchard was thoroughly sprayed with a 20% mechanical mixture of kerosene and water. A little later one of the originally infested trees was again sprayed with undiluted crude petroleum. The crude petroleum was also applied to two infested peach trees and to a number of apple trees. In no case did it do any injury.

The result of this treatment simply goes to confirm the truth of the following two propositions: 1st, that when a tree is once infested with scale it is almost impossible to entirely eradicate it. 2nd, that by spraying with kerosene or crude petroleum its numbers can be so reduced that it does the trees no harm. The spraying has probably not exterminated the scale on a single tree where it had gained a lodgment, but there are left only a few scattered individuals on any of the trees. These facts have come to be quite widely recognized and they should be made the basis for the treatment of every outbreak of the scale. When it is first discovered in a new locality, if it is confined to a few trees or even to one or more entire orchards, by all means cut them out at once and burn them, for this is the only sure way of stamping out the pest. On the other hand in communi-

ties where it is known to occur somewhat widely it is needless to cut down infested trees for if taken in time the scale can be so controlled by annual or even biennial sprayings that it will do little if any harm. Of course the spraying is a rather heavy expense and the occasion for it should be avoided by taking every precaution to keep the premises clear of this pest.

BULLETIN No. 113. FEBRUARY, 1901.

ALABAMA.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Co-operative Experiments with Cotton in 1899-1900.

By J. F. DUGGAR, Agriculturist.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON IN 1899 and 1900.

BY J. F. DUGGAR.

These experiments were conducted under the direction of the Agricultural Department of this Station in 1899 and 1900. These tests in 1899 were made by farmers in nineteen localities; the tests made in 1900 were conducted in eighteen localities, not including in this count the few experimenters who failed to report results.

The method of conducting the experiments was the same as in former years. The plots were each one-eighth acre in area.

The following is the list of those who made experiments in 1899 and 1900 and who reported results.

Name.	Post Office.	County.	Page
Agricultural School	Hamilton	Marion	50
Autrey, A.	Berneys	Talladega	50
Ballard J. L.	Jackson	Clarke	40
Bevill, W. C.	Bevill	Choctaw	38
Borland, T. M.	Dothan	Henry	46
Chappell, C. A.	Dillburg	Pickens	51
Chism, W. T	Vick	Bibb	20
Culver, J. W.	Jackson	Clarke	40
Cunningham, E. L.	Furman	Wilcox	11
Cory, A. F.	Evergreen	Conecuh	52
Daffin, E. J.	Tuscaloosa	Tuscaloosa	17
Duncan, J. S.	Maple Grove	Cherokee	13
Experiment Station	Auburn	Lee	24
Foster, J. D.	Auburn	Lee	27
French, J. W.	Gordo	Pickens	15

THE FERTILIZERS USED.

These consisted of high grade acid phosphate guaranteed to contain at least 14 per cent. of available phosphoric acid.

The following table gives the plan of the experiment and the composition of the fertilizers employed:

Pounds per acrk of fertilizers, nitrogen, phosphoric acid, and potash used, and composition of each mixture.

Plot No.	FERTILIZERS. Amount per acre.	FERTILIZERS. KIND.	MIXTURE CONTAINS. Nitrogen.	MIXTURE CONTAINS. †Available phosphoric acid.	MIXTURE CONTAINS. Potash	Cost of mixture, per ton.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	
1	200	Cotton seed meal.....	13.58	5.76	3.54	
		In 100 lbs s c. meal. *	6.79	2.88	1.77	$ 19.00
2	240	Acid phosphate....	....	36.12	......	
		In 100 lbs. acid phos	....	15.05	.....	12.50
4	200	Kainit	....	....	24.60	
		In 100 lbs kainit.	....	......	12.30	13.75
5	200 240	Cotton seed meal.... Acid phosphate	13.58	41.88	3.54	
		In 100 lbs. above mixt.	3.09	9.52	.80	15.45
6	200 200	Cotton seed meal.... Kainit	13.58	5.76	28.14	
		In 100 lbs. above mixt	3.39	1.44	7.03	16.38
7	240 200	Acid phosphate ... Kainit ...	....	......	....	
		In 100 lbs. above mixt	....	8.21	5.59	13.09
9	200 240 200	Cotton seed meal.... Acid phosphate..... Kainit	13.58	41.88	28.14	
		In 100 lbs above mixt	2.12	6.54	4.39	14.94
10	200 240 100	Cotton seed meal... Acid phosphate ..... Kainit	13.58	41.88	15.84	
		In 100 lbs. above mixt	2.59	7.75	2.93	15.11

* Average of many analyses.
† Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by $1\frac{3}{14}$.

The phosphate and cotton seed were purchased at market prices. Most of the kainit was donated by the German Kali Works.

In determining the increase over the unfertilized plots, the yield of the fertilized plots, Nos. 4, 5, 6 and 7, is compared with both unfertilized plots, lying on either side, giving to each unfertilized plot a weight inversely proportional to its distance from the plot under comparison. This method of comparison tends to compensate for variations in the fertility of the several plots.

It should be remembered that seasons, as well as soils, determine the effects of fertilizers, so that to be absolutely reliable a fertilizer experiment should be repeated for several years on the same kind of soil. Abnormal weather conditions in 1899 and 1900 resulted in an unusually large proportion of inconclusive experiments.

THE WEATHER IN 1899 and 1900.

The following data are taken from the records of the Alabama Section of the Weather Bureau for 1899 and 1900 and give average results of a number of stations:

	1899.	1900.
Rainfall for April, inches	2.80	9.06
Rainfall for May, inches	2.03	2.64
Rainfall for June, inches	2.54	11.80
Rainfall for July, inches	6.76	4.93
Rainfall for August, inches	3.68	2.89
Rainfall for September, inches	.66	4.00
Rainfall for October, inches	2.18	5.64
Rainfall for November, inches	3.04	3.88

It will be seen from the above that the spring and early summer of 1899 were very dry. Complaints of drought in that year were general. In 1900 an excessive precipitation in April and June greatly injured crops, and in addition there was in many localities a severe drought in August.

Two more unfavorable seasons in immediate succession seldom occur.

EXPERIMENTS MADE BY W. F. FULTON, LARIMORE OR COLLINSVILLE, DEKALB COUNTY.

Dark gray, mulatto, or reddish, stiff soil; subsoil red clay.

An experiment with cotton has been conducted on this farm in Big Wills Valley for three years in succession on land cleared about three-quarters of a century ago. The crop preceding the cotton experiments of both 1899 and 1900 was corn. The early part of the summer of 1899 was rather dry; in 1900 "from the time the cotton was planted until it was laid by my notes show almost continuous rain,—the wettest season in the knowledge of the oldest inhabitant."

The results for 1898 were printed in Bulletin No. 102. Those for 1899 and 1900 are given in the following table:

Larimore or Collinsville experiment with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899 Yield seed cotton per acre.	1899 Increase over unfertilized plots.	1900 Yield seed cotton per acre.	1900 Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal......	648	208	544	0
2	240	Acid phosphate........	760	320	880	336
3	00	No fertilizer..........	440	....	544	....
4	200	Kainit	648	205	666	107
5	200 240	Cotton seed meal.... Acid phosphate......	880	431	1120	550
6	200 200	Cotton seed meal.... Kainit	736	287	920	337
7	240 200	Acid phosphate...... Kainit.......	856	404	1064	468
8	00	No fertilizer..........	456	....	608	....
9	200 240 200	Cotton seed meal.... Acid phosphate...... Kainit..............	976	520	1208	600
10	200 240 100	Cotton seed meal.... Acid phosphate... .. Kainit	912	456	1032	424

Increase of seed cotton per acre when cotton seed meal was added:

	1899	1900
To unfertilized plot	208 lbs.	0 lbs.
To acid phosphate plot	114 lbs.	214 lbs.
To kainit plot	82 lbs.	230 lbs.
To acid phosphate and kainit plot.	116 lbs.	132 lbs.
Average increase with cotton seed meal.........................	**130 lbs.**	**144 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	320 lbs.	336 lbs.
To cotton seed meal plot	126 lbs.	550 lbs.
To kainit plot	233 lbs.	263 lbs.
To cotton seed meal and kainit plot	233 lbs.	263 lbs.
Average increase with acid phosphate	**219 lbs.**	**378 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	205 lbs.	107 lbs.
To cotton seed meal plot	79 lbs.	337 lbs.
To acid phosphate plot	84 lbs.	132 lbs.
To cotton seed meal and acid phosphate plot	86 lbs.	50 lbs.
Average increase with kainit	**116 lbs.**	**157 lbs**

The principal need of this soil, clearly shown in each of three tests, is for phosphate, which has paid a large profit, whether employed alone or in combination with any of the other materials. The increase attributable to phosphate in each of the three years is respectively 464, 219, and 378 pounds of seed cotton per acre. Cotton seed meal usually increased the yield more than enough to cover its cost, the averages for the 3 years being respectively 152, 130, and 144 pounds of seed cotton. Its relatively slight effect suggests the advisability of reducing the amount of cotton seed meal, of which about half as much as of phosphate might be used for cotton.

Kainit was the least beneficial on this soil of the ingredients of the complete fertilizer and the figures indicate that its addition to the mixture of phosphate and kainit was not profitable.

EXPERIMENT MADE BY W. M. PURIFOY, 2 MILES NORTH-EAST OF SNOW HILL, WILCOX COUNTY.

White bald prairie; subsoil, white rotten limestone.

This experiment was made in 1899 on land especially favorable to the development of black rust of cotton. The land was not broken until May 25, when it was bedded with a one-horse plow. "Many stalks had nothing on them on account of coming up too late. Extreme drought ruined the experiment."

The table on page 11 gives the yields and the subjoined analysis of results of Mr. Purifoy's tests, both in 1898 and 1899, shows the increase attributable to each fertilizer, when used alone or in combinations under cotton growing on poor white prairie soil.

Increase of seed cotton per acre when cotton seed meal was added:

	1898.	v899.
To unfertilized plot	128 lbs.	144 lbs.
To acid phosphate plot	27 lbs.	16 lbs.
To kainit plot	227 lbs.	144 lbs.
To acid phosphate and kainit plot	141 lbs.	128 lbs.
Average increase with cotton seed meal	**131 lbs.**	**100 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	200 lbs.	208 lbs.
To cotton seed meal plot	99 lbs.	48 lbs.
To kainit plot	209 lbs.	240 lbs.
To cotton seed meal and kainit plot	123 lbs.	224 lbs.
Average increase with acid phosphate	**158 lbs.**	**180 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	27 lbs.	0 lbs.
To cotton seed meal plot.........	72 lbs.	0 lbs.
To acid phosphate plot	18 lbs.	32 lbs.
To cotton seed meal and acid phosphate plot	96 lbs.	176 lbs.
Average increase with kainit......	**41 lbs.**	**52 lbs.**

In the above paragraphs the results of Mr. Purifoy's experiment in 1898 are republished to show the close correspondence between the results of the two years, both tending to indicate that the phosphate was more beneficial than cotton seed meal and that kainit was of least effect.

Snow Hill and Furman experiments with cotton on white bald prairie.

Plot No.	Fertilizers. Amount per acre	Fertilizers. Kind.	Snow Hill 1899. Yield seed cotton per acre.	Snow Hill 1899. Increase over unfertilized plots.	Furman. 1900. Yield seed cotton per acre.	Furman. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal......	144	144	480	80
2	240	Acid phosphate.......	208	208	480	80
3	00	No fertilizer...........	00	....	400	....
4	200	Kainit.................	00	0	376	—27
5	200 240	Cotton seed meal... Acid phosphate......	192	192	664	258
6	200 200	Cotton seed meal.... Kainit	144	144	488	79
7	240 200	Acid phosphate ..... Kainit..............	240	240	616	204
8	00	No fertilizer	00	....	416	....
9	200 240 200	Cotton seed meal . . Acid phosphate...... Kainit..............	368	368	624	208
10	200 240 100	Cotton seed meal... Acid phosphate ..... Kainit............	416	416	616	200

EXPERIMENT MADE IN 1900 BY E. L. CUNNINGHAM, 6 MILES EAST OF FURMAN, WILCOX COUNTY.

White prairie, the surface dark gray; sub-soil white rotten limestone.

The original growth, cleared about 30 or 40 years ago, is reported as oak and hickory with some short-leaf pine. The field was in cotton in 1897 and 1898 and uncultivated in 1899.

The depth of plowing was 5 or 6 inches. On Plot 5 there was considerable black rust, but very little on Plots 9 and 10, where a complete fertilizer containing kainit was used. The stand was full and uniform. There was too much rain.

The yields are given in the table above.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	80 lbs.
To acid phosphate plot	178 lbs.
To kainit plot	106 lbs.
To acid phosphate and kainit plot	4 lbs.
Average increase with cotton seed meal, - -	**92 lbs.**

Increase of seed cotton per acre when acid phosphate was used.

To unfertilized plot	80 lbs.
To cotton seed meal plot	178 lbs.
To kainit plot	231 lbs.
To cotton seed meal and kainit plot	129 lbs.
Average increase with acid phosphate, - -	**130 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—27 lbs.
To cotton seed meal plot	—1 lbs.
To acid phosphate plot	124 lbs.
To seed cotton meal and acid phosphate plot	—50 lbs.
Average increase with kainit,	**12 lbs.**

Mr. Cunningham's experiment, like both of the tests made by Mr. Purifoy, on the same class of land, white prairie, indicates that phosphate was most needed. The largest yield was made with a mixture of cotton seed meal and phosphate. Kainit did not increase the yield, though it did seem to somewhat restrain the rust on Plots 9 and 10.

It should be noted that white prairie soil was not very responsive to commercial fertilizers and that none of these paid a very large profit.

Although phosphate was undoubtedly useful in each of these experiments, its effects were far less notable than the favorable influence that is exerted by adding suitable vegetable matter to this class of soils. We cannot yet recommend the use of phosphate on these soils, believing that the same money invested in the seed of melilotus or of other renovating plant would be more profitably spent.

EXPERIMENTS MADE BY J. S. DUNCAN ON G. W. FREEMAN'S FARM, 1½ MILES SOUTHWEST OF MAPLE GROVE, CHEROKEE COUNTY.

In 1899 the test was made on gray sandy upland, with red subsoil; in 1900 on light alluvial second bottom of a dark gray color, with red subsoil. Both fields had been cleared for more than a quarter of a century. The

cotton experiment of 1899 was preceded by cotton, that of 1900 by corn.

In 1899 the summer was excessively dry, in 1900 excessively wet.

Maple Grove experiment with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Maple Grove. 1899. Yield seed cotton per acre.	Maple Grove. 1899. Increase over unfertilized plots	Maple Grove. 1900. Yield seed cotton per acre.	Maple Grove. 1900. Increase over unfertilized plots
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal......	800	176	1036	220
2	240	Acid phosphate........	752	128	932	116
3	00	No fertilizer..........	624	....	816	....
4	200	Kainit	616	—43	920	106
5	200 240	Cotton seed meal.... Acid phosphate	960	266	992	181
6	200 200	Cotton seed meal.... Kainit	804	175	1032	223
7	240 200	Acid phosphate...... Kainit..............	776	12	1024	218
8	00	No fertilizer.........	800	....	804	....
9	200 240 200	Cotton seed meal ... Acid phosphate...... Kainit..............	1024	224	1080	276
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit	992	192	1032	228

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	176 lbs.	220 lbs.
To acid phosphate plot...........	138 lbs.	65 lbs.
To kainit plot	218 lbs.	117 lbs.
To acid phosphate and kainit plot.	212 lbs.	58 lbs.
Average increase with cotton seed meal.........................	**186 lbs.**	**115 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	128 lbs.	116 lbs.
To cotton seed meal plot	90 lbs.	—39 lbs.
To kainit plot	55 lbs.	112 lbs.
To cotton seed meal and kainit plot	49 lbs.	53 lbs.
Average increase with acid phosphate	**81 lbs.**	**61 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—43 lbs.	106 lbs.
To cotton seed meal plot	—1 lb.	3 lbs.
To acid phosphate plot	—116 lbs.	102 lbs.
To cotton seed meal and acid phosphate plot	—42 lbs.	95 lbs.
Average increase (or decrease[—]) with kainit	**—51**	**77 lbs.**

In both years cotton seed meal was the most important fertilizer for cotton; phosphate afforded a small increase, possibly because of abnormal weather conditions; kainit was useless on upland in 1899 and scarcely profitable in 1900 on second bottom land.

EXPERIMENT MADE BY J. W. FRENCH, 3 MILES NORTH OF GORDO, PICKENS COUNTY.

This test was conducted in 1899 on gray upland, and in 1900 on dark sandy upland, both having red subsoils, rather retentive of water. The cotton experiment of 1899 was preceded by corn, that of 1900 by cotton. In both cases the tests were on old fields, cleared of pines and reclaimed four to seven years before the experiments began.

The former season was exceedingly dry; the latter, "the most unfavorable ever known, first too wet and then too dry." The stand was reported as excellent.

Gordo experiment with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899. Yield seed cotton per acre.	1899. Increase over unfertilized plots.	1900. Yield seed cotton per acre.	1900. Increase over unfertilized plots.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	536	200	696	312
2	240	Acid phosphate	848	512	568	184
3	00	No fertilizer	336	....	384	....
4	200	Kainit	360	38	400	11
5	200 240	Cotton seed meal Acid phosphate	944	637	728	335
6	200 200	Cotton seed meal Kainit	528	235	584	186
7	240 200	Acid phosphate Kainit	736	458	552	149
8	00	No fertilizer	264	....	408	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1032	868	888	480
10	200 240 100	Cotton seed meal Acid phosphate Kainit	928	664	818	440

Increase of seed cotton per acre when cotton seed meal was added:

	1899..	1900.
To unfertilized plot	200 lbs.	312 lbs.
To acid phosphate plot..........	125 lbs.	151 lbs.
To kainit plot.......	197 lbs.	175 lbs.
To acid phosphate and kainit plot....	410 lbs.	331 lbs.
Average increase with cotton seed meal,	**238 lbs.**	**242 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	512 lbs.	184 lbs.
To cotton seed meal plot	437 lbs.	23 lbs.
To kainit plot	420 lbs.	138 lbs.
To cotton seed meal and kainit plot ...	633 lbs.	294 lbs.
Average increase with acid phosphate,	**501 lbs.**	**160 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	38 lbs.	11 lbs.
To cotton seed meal plot	—35 lbs.	—126 lbs.
To acid phosphate plot..............	—54 lbs.	—35 lbs.
To cotton seed meal and acid phosphate plot	231 lbs.	145 lbs.
Average increase with kainit, - -	**63 lbs.**	**—1 lb.**

Phosphate was the material of most importance for the gray soil and it was also needed on the darker soil. Cotton seed meal was first in importance in 1900 and second in 1899. Kainit was useless except in a complete fertilizer, in which combination it was slightly profitable, but never so important as phosphate or cotton seed meal.

EXPERIMENT CONDUCTED BY E. J. DAFFIN, 3 MILES S. OF TUSCALOOSA, TUSCALOOSA COUNTY.

This test was made in 1900 on the F. S. Moody farm. The soil is described as second bottom, sandy, and of a reddish gray color; the subsoil, as red clay. The original growth, removed more than half a century ago, is sweet gum, black gum, persimmon, and sassafras. The preceding crop was cotton.

June and July brought an excessive rainfall, interfering with cultivation and August was very dry. There were 1,065 plants per eighth-acre plot. "Red rust" was reported as injurious alike on all plots.

Both cotton seed meal and acid phosphate, whether used alone, or in any combination, greatly increased the yield and afforded a good profit. Kainit was practically ineffective except in combination with the other two fertilizers, where it seems to have increased the yield to a profitable extent; the complete fertilizer, con-

taining kainit (Plot 9) affording an increase greater by 236 pounds of seed cotton per acre than the increment where only phosphate and meal were used together. (Plot 5.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	216 lbs.
To acid phosphate plot	356 lbs.
To kainit plot	259 lbs.
To acid phosphate and kainit plot	529 lbs.
Average increase with cotton seed meal	**340 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	152 lbs.
To cotton seed meal plot	292 lbs.
To kainit plot	189 lbs.
To cotton seed meal and kainit plot	459 lbs.
Average increase with acid phosphate	**273 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	26 lbs.
To cotton seed meal plot	69 lbs.
To acid phosphate plot	63 lbs.
To cotton seed meal and acid phosphate	236 lbs.
Average increase with kainit	**99 lbs.**

Mr. Daffin also conducted similar tests in 1897 and 1898 on red sandy upland, with red clay subsoil, two and one-half miles east of Tuscaloosa. In both years phosphate was by far the chief need of that soil, but both cotton seed meal and kainit afforded considerable increase, so that the greatest profit was obtained by the use of a complete fertilizer containing all three of these materials.

EXPERIMENT MADE IN 1899 BY E. MELTON, ONE MILE WEST OF HUGENT, FAYETTE COUNTY.

Dark or "mulatto" soil, with red clay subsoil.

The original growth, removed about 50 years ago, is reported as short-leaf pine, oak, and hickory. The three preceding crops were corn. The plants were free from rust.

As shown in the detailed statement below, phosphate was the fertilizer chiefly needed by this soil, and its use, alone and in every combination, was highly profitable, the average increase attributable to phosphate being 364 pounds of seed cotton per acre. Cotton seed meal was next in importance, affording an average increase of 168 pounds per acre.

The most profitable fertilizer was a mixture of acid phosphate and cotton seed meal. Kainit was not needed.

Increase of seed cotton per acre when cotton seed meal was used:

To unfertilized plot	128 lbs.
To acid phosphate plot	160 lbs.
To kainit plot	176 lbs.
To acid phosphate and kainit plot	208 lbs.
Average increase with cotton seed meal	**168 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	400 lbs.
To cotton seed meal plot	432 lbs.
To kainit plot	296 lbs.
To cotton seed meal and kainit plot	328 lbs.
Average increase with acid phosphate	**364 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	72 lbs.
To cotton seed meal plot	120 lbs.
To acid phosphate plot	—32 lbs.
To cotton seed meal and acid phosphate plot	16 lbs.
Average increase with kainit	**44 lbs.**

EXPERIMENTS CONDUCTED BY W. T. CHISM, 1 MILE SOUTH-EAST OF VICK, BIBB COUNTY.

Both experiments were conducted on dark gray sandy or loamy branch bottom soil, rather retentive of moisture. The earlier experiment was preceded by corn, the later one by cotton.

The field had been cleared about 75 years and the original growth is reported as sweet gum, red and white oak, hickory, ash, poplar, cucumber tree, and a few short-leaf pines, and chestnuts.

The latter part of the season of 1899 was dry and unfavorable and in 1900 there was almost continuous wet weather during the season of cultivation. The soil was worked June 25, 1900, when too wet, by which the experimenter reports that the crop was greatly damaged.

Increase of seed cotton per acre when cotton seed meal was used.

	1899.	1900.
To unfertilized plot	256 lbs.	62 lbs.
To acid phosphate plot	96 lbs.	77 lbs.
To kainit plot	244 lbs.	100 lbs.
To acid phosphate and kainit plot	92 lbs.	15 lbs.
Average increase with cotton seed meal	**172 lbs.**	**64 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	104 lbs.	24 lbs.
To cotton seed meal plot	—56 lbs.	39 lbs.
To kainit plot	116 lbs.	78 lbs.
To cotton seed meal and kainit plot	—24 lbs.	—7 lbs.
Average increase with acid phosphate,	**35 lbs.**	**34 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—24 lbs.	—1 lb.
To cotton seed meal plot	—32 lbs.	37 lbs.
To acid phosphate plot	—12 lbs.	53 lbs.
To cotton seed meal and acid phosphate plot	—16 lbs.	—9 lbs.
Average increase with kainit	**—20 lbs.**	**20 lbs.**

In 1900 cotton seed meal was the only fertilizer that was very effective. In 1899 none of them were decidedly beneficial. On account of the extremely unfavorable weather in both years, it is probable that neither experiment indicates the real needs of this soil, so that we must place these tests in the class of inconclusive experiments.

EXPERIMENT MADE IN 1899 BY J. P. SLATON, 7 MILES SOUTH OF NOTASULGA AND 7 MILES N. E. OF TUSKEGEE, MACON COUNTY.

Gray sandy upland, with retentive red clay subsoil.

The field was originally cleared about 75 years ago, and cleared of the second growth about 12 years ago. The original growth was long leaf pine and oak. The preceding crop was cotton.

The cotton did not come up until the first of June and

this late start may have kept the fertilizers from exerting their full effect. The stand was good.

As shown in the table on page 23 and in the detailed statements below, phosphate and cotton seed meal were both effective in nearly every combination. Kainit was not needed.

Mr. Slaton conducted an experiment in 1898 (see Bulletin No. 102) on similar soil. In that year acid phosphate and cotton seed meal were even more profitable than in 1900 and kainit was useless. It seems that this gray soil, with a clay subsoil near at hand, needs only a mixture of acid phosphate and cotton seed meal to produce a profitable cotton crop.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	192 lbs.
To acid phosphate plot	43 lbs.
To kainit plot	110 lbs.
To acid phosphate and kainit plot	123 lbs.
Average increase with cotton seed meal	**117 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	176 lbs.
To cotton seed meal plot	27 lbs.
To kainit plot	145 lbs.
To cotton seed meal and kainit plot	158 lbs.
Average increase with acid phosphate	**127 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	20 lbs.
To cotton seed meal plot	—62 lbs.
To acid phosphate plot	—11 lbs.
To cotton seed meal and acid phosphate plot	69 lbs.
Average increase with kainit	**4 lbs.**

Tuscaloosa, Hugent, Vick and Notasulga experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Tuscaloosa. 1900. Yield seed cotton per acre.	Tuscaloosa. 1900. Increase over unfertilized plots	Hugent. 1899. Yield seed cotton per acre.	Hugent. 1899. Increase over unfertilized plots.	Vick. 1899. Yield seed cotton per acre.	Vick. 1899. Increase over unfertilized plots.	Vick 1900. Yield seed cotton per acre.	Vick 1900. Increase over unfertilized plots.	Notasulga. 1899. Yield seed cotton per acre	Notasulga. 1899. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	680	216	464	128	992	256	526	62	592	192
2	240	Acid phosphate	616	152	736	400	840	104	488	24	576	176
3	00	No fertilizer	464	......	336	......	736	.....	464	....	400	....
4	200	Kainit	496	26	400	72	668	—24	452	—1	544	20
5	200 240	Cotton seed meal Acid phosphate	984	508	880	560	848	200	544	101	724	219
6	200 200	Cotton seed meal Kainit	768	285	560	248	824	220	532	99	616	130
7	240 200	Acid phosphate Kainit	704	2 5	672	368	652	92	500	77	632	165
8	00	No fertilizer	496	....	296	......	516	....	412	....	448	......
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1240	744	872	576	700	184	504	92	736	288
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1040	544	752	456	840	324	496	84	744	296

Auburn Experiments in 1898, 1899, & 1900, on Experiment Station Farm.

These tests were made on three adjacent areas set apart for permanent fertilizer experiments with cotton, corn, and oats. The soil is of the same character on all three areas, as was also the previous fertilization of each plot.

All three of the cotton crops were preceded by oats fertilized like the corresponding cotton plot.

In 1900 each plot received the same fertilizer as in 1898 and 1899. Hence the results should show not only the immediate effects of fertilizers, but the residual on cumulative effects, if there are any on this light soil.

Contrary to our usual custom, cowpeas were not sown after the oats, but instead a thin growth of crabgrass, rag weed, and poverty weed covered the ground during the summer and fall following the harvesting of each oat crop.

Commercial fertilizers, chiefly acid phosphate, had been liberally, though not lavishly, employed annually for a number of years before the experiment began.

The soil is a deep sand bed nearly free from stone or gravel, and the plots occupy the crest of a hill.

The dates of planting were April 15, 1898; April 11, 1899; and April 24, 1900. The stand was nearly perfect except in 1900, when there was some slight want of uniformity, so that the figures for 1900 represent the yields after being corrected on the basis of an equal number of plants on each plot.

The Peerless variety was used each year. In 1898 black rust was quite injurious. September 23 it was estimated that the plants on the plots on which kainit had been used had shed 50 to 70 per cent. of their leaves while

the plants receiving no kainit had shed 75 to 92 per cent of their leaves.

The prevalence of black rust probably accounts, at least in part, for the very favorable showing made by kainit in 1898, for numerous experiments recorded in the bulletins of this Station show that kainit generally decreases the injury from black rust.

Fertilizer experiments with cotton at Auburn, 1898, 1899 and 1900 on Experiment Station farm.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1898. Yield.	1898. Increase.	1899. Yield.	1899. Increase.	1900. Yield.	1900. Increase.	Average increase 3 years.
	Lbs.		*Lbs*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs*	*Lbs.*
1	200	Cotton seed meal......	889	214	1008	234	379	35	161
2	240	Acid phosphate........	853	178	819	145	266	—78	82
3	00	No fertilizer...........	675	..	774		344	...	......
4	200	Kainit....	783	122	1049	262	360	46	143
5	200 240	Cotton seed meal.... Acid phosphate	1013	346	1029	231	393	109	229
6	200 200	Cotton seed meal.... Kainit..	1192	529	1075	265	434	180	325
7	240 200	Acid phosphate...... Kainit	1145	486	1051	229	246	22	246
8	00	No fertilizer..........	655	....	833	..	194	...	......
9	200 240 200	Cotton seed meal.... Acid phosphate...... Kainit	1177	522	1152	319	435	241	361
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit	....	....	1055	422	....	....	......

Increase in yield from cotton seed, acid phosphate, and kainit on Experiment Station Farm in 1898, 1899 and 1900.

	Increase; lbs. seed cotton per acre.			
Increase of seed cotton per acre where cotton seed meal was added	1898	1899	1900.	Average, 3 years.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
To unfertilized plot......................	214	234	35	161
To acid phosphate plot..................	168	86	187	147
To kainit plot........	407	3	134	181
To acid phosphate and kainit plot	36	90	219	115
Average increase with **cotton seed meal.**	206	103	144	**151**
Increase of seed cotton per acre where phosphate was added				
To unfertilized plot......................	178	145	—78	82
To cotton seed meal plot	132	—3	194	80
To kainit plot....	364	—33	--24	102
To cotton seed meal and kainit plot......	—7	54	61	36
Average increase with **acid phosphate**...	167	41	38	**82**
Increase of seed cotton per acre where kainit was added				
To unfertilized plot......................	122	262	46	143
To cotton seed meal plot.................	315	31	145	164
To acid phosphate plot	308	84	100	164
To cotton seed meal and acid phos. plot..	176	88	182	132
Average increase with **kainit**............	235	116	106	**152**

In 1898 the greatest increase in yield was obtained by the use of a mixture of cotton seed meal and kainit. This mixture was a close second to the complete fertilizer in 1899 and 1900 and its average increase for the three years lacked only 36 pounds of seed cotton per acre of equalling the increase due to a complete fertilizer.

Quite unexpectedly, acid phosphate has not been very effective. If this is due to the accumulation of a sufficient supply of phosphoric acid in the soil from the phosphate applied annually for many years before the

beginning of the experiment, the value of applications of phosphate should become more marked in future as this supply is exhausted.

It would be safe to estimate the amount of phosphate applied annually during the decade before the test began at 200 pounds per acre or less. Results on most soils seem to indicate that phosphate is the most important single fertilizing material for cotton.

EXPERIMENTS CONDUCTED BY J. D. FOSTER, 1 MILE SOUTH OF AUBURN, LEE COUNTY.

Light sandy loam, gray upland; subsoil yellowish clay or loam, not compact.

The experiments of 1899 and 1900 were conducted in different parts of the same field, on identical soil.

The field, on which the original growth was reported as long-leaf pine, had been in cultivation for a great many years.

The crop preceding the experiment of 1899 was corn, with drilled cowpeas between the rows. The peas made only a moderate growth and were grazed in the fall of 1898.

The stand of cotton was uniform. In 1900 cotton was planted May 25. The cotton experiment in 1900 occupied the plots that had been used in 1899 for a similar fertilizer experiment with corn, (having no cowpeas between the rows.) Hence the results of the cotton experiment of 1900 should show not only the immediate effects of each fertilizer, but also the residual or second-year effects, if there were any lasting benefit from commercial fertilizers used on this light soil.

Auburn experiment with cotton on J. D. Foster farm.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899. Yield seed cotton per acre.	1899. Increase over unfertilized plots.	1900. Yield seed cotton per acre.	1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	616	280	600	240
2	240	Acid phosphate........	528	192	488	128
3	00	No fertilizer...........	336	....	360	....
4	200	Kainit.................	520	183	432	79
5	200 240	Cotton seed meal.... Acid phosphate......	744	405	744	397
6	200 200	Cotton seed meal.... Kainit	648	307	688	347
7	240 200	Acid phosphate...... Kainit.......	568	225	528	194
8	00	No fertilizer...........	344	....	328	....
9	200 240 200	Cotton seed meal.... Acid phosphate ..... Kainit..............	664	320	726	398
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit....	656	312	688	360

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	280 lbs.	240 lbs.
To acid phosphate plot	213 lbs.	269 lbs.
To kainit plot	124 lbs.	268 lbs.
To acid phosphate and kainit plot....	95 lbs.	204 lbs.
Average increase with cotton seed meal,	**178 lbs.**	**245 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	192 lbs.	128 lbs.
To cotton seed meal plot	125 lbs.	157 lbs.
To kainit plot	42 lbs.	115 lbs.
To cotton seed meal and kainit plot ..	13 lbs.	51 lbs.
Average increase with acid phosphate,	**93 lbs.**	**113 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	183 lbs.	79 lbs.
To cotton seed meal plot	27 lbs.	107 lbs.
To acid phosphate plot	33 lbs.	66 lbs.
To cotton seed meal and acid phosphate plot	—85 lbs.	1 lb.
Average increase with kainit	**39 lbs.**	**63 lbs.**

The figures for the two years agree closely and show that a larger increase was afforded by cotton seed meal than by any other single material. The most profitable of all the fertilizers was a mixture of cotton seed meal and phosphate. Kainit was unprofitable.

Experiment Conducted by Judge T. J. Thomason, 2 miles south of Ranburne (near Kaylor), Randolph County.

This experiment was made in 1899 on gray land, with yellow subsoil. The soil is described as table land rather retentive of moisture. The preceding crop was cotton.

This is the third experiment on a uniform plan conducted by Judge Thomason. (See Bulletin No. 107; p. 274). If we take the average increase of each fertilizer under all conditions we have for the entire period of three years an average increase of 187 pounds of seed cotton per acre attributable to cotton seed meal, 197 to phosphate, and only 31 to kainit. The inference is plain that a mixture of cotton seed meal and phosphate was all that cotton needed on this soil, and that the addition of kainit, at the rate of 200 pounds per acre, was usually unprofitable. The results for 1899, when kainit afforded a slight profit, were more favorable to potash than were the results of the two previous tests on this soil.

The following statements show the average increase in yield for the entire period of three years.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	217 lbs.
To acid phosphate plot	137 lbs.
To kainit plot	156 lbs.
To acid phosphate and kainit plot	238 lbs.
Average increase with cotton seed meal	**187 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	264 lbs.
To cotton seed meal plot	184 lbs.
To kainit plot	128 lbs.
To cotton seed meal and kainit plot	210 lbs.
Average increase with acid phosphate	**197 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	90 lbs.
To cotton seed meal plot	29 lbs.
To acid phosphate plot	—80 lbs.
To acid phosphate and cotton seed meal	54 lbs.
Average increase with kainit	**31 lbs.**

EXPERIMENT CONDUCTED BY T. T. MEADOWS ½ MILE NORTH OF CUSSETA, CHAMBERS COUNTY.

Soil, red, stoney; subsoil red clay.

This test, made in 1899, is the third experiment conducted on similar soil by Mr. Meadows. (See Bulletin No. 107, p. 274.)

Giving attention to the average results for the three years we find that the principal need of this soil was for

acid phosphate, which gave an average increase of 202 pounds of seed cotton per acre. Cotton seed meal was added to the phosphate with profit, but kainit was not needed.

The red clay soils of the Metamorphic Region in this part of the State seem to contain sufficient potash for the ordinary needs of the cotton crop, though when black rust is prevalent kainit is beneficial even here.

Statements of the average increase in yield for the *three years* follows:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	109 lbs.
To acid phosphate plot	156 lbs.
To kainit plot	164 lbs.
To acid phosphate and kainit plot	128 lbs.
Average increase with cotton seed meal	**139 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	192 lbs.
To cotton seed meal plot	239 lbs.
To kainit plot	217 lbs.
To cotton seed meal and kainit plot	189 lbs.
Average increase with acid phosphate	**202 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—8 lbs.
To cotton seed meal plot	43 lbs.
To acid phosphate plot	15 lbs.
To cotton seed meal and acid phosphate plot	—9 lbs.
Average increase with kainit	**10 lbs.**

EXPERIMENT CONDUCTED IN 1900 BY W. N. INGRAM, 8 MILES EAST OF OPELIKA, LEE COUNTY.

The description of the land seems to indicate that the soil was a yellowish loam, with subsoil of somewhat the same character, and not compact. The original growth is reported as oak and hickory, which had been removed about forty years before. The rainfall was excessive in June. The preceding crop was corn.

The results are not entirely conclusive, but on the whole they show that cotton seed meal was profitable and that the returns from the other fertilizers this wet year were not satisfactory.

Increase of seed cotton per acre when cotton seed meal was added:
added:

To unfertilized plot	248 lbs.
To acid phosphate plot	—30 lbs.
To kainit plot	242 lbs.
To acid phosphate and kainit plot	180 lbs.
Average increase with cotton seed meal	**160 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	96 lbs.
To cotton seed meal plot	—182 lbs.
To kainit plot	87 lbs.
To cotton seed meal and kainit plot	25 lbs.
Average increase with acid phosphate	**7 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	29 lbs.
To cotton seed meal plot	23 lbs.
To acid phosphate plot	20 lbs.
To cotton seed meal and acid phosphate plot	230 lbs.
Average increase with kainit	**75 lbs.**

Kaylor, Cusseta and Opelika experiments with cotton.

	Fertilizers.		Kaylor. 1899.		Cusseta. 1899		Opelika. 1900.	
Plot No.	Amount per acre.	Kind.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal...	888	112	296	104	1000	248
2	240	Acid phosphate.....	848	72	456	264	848	96
3	00	No fertilizer........	776	......	192	..	752	......
4	200	Kainit..........	804	49	152	--45	800	29
5	200 240	Cotton seed meal. Acid phosphate...	1084	350	504	302	856	66
6	200 200	Cotton seed meal. Kainit............	914	232	304	97	1080	271
7	240 200	Acid phosphate ... Kainit............	872	182	472	260	944	116
8	00	No fertilizer........	668	......	216	......	848	......
9	200 240 200	Cotton seed meal. Acid phosphate... Kainit.....	1124	456	640	424	1144	296
10	200 240 100	Cotton seed meal. Acid phosphate... Kainit............	1140	472	560	344	1112	264

Experiment Conducted by J. C. Watkins $1\frac{1}{2}$ miles north of Burnt Corn, Monroe County.

The experiments of 1899 and 1900 were made on poor yellowish or chocolate-colored upland sandy soil, with red subsoil. This soil bakes badly.

The rainfall in 1900 was excessive. There was no black rust in either year.

The table on page 34 gives the yields for 1899 and 1900. This is the fourth experiment made by Mr. Watkins according to the present plan. (See Bulletin No. 197, p. 274). Most of the tests have shown that phosphate was more important than cotton seed meal and that kainit only increased the yield; however in 1900 kainit was the most effective fertilizer.

The average results for 4 years show that phosphate gave an average increase of 207, cotton seed meal of 151, and kainit of 70 pounds of seed cotton per acre.

Burnt Corn experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	1899. Yield seed cotton per acre.	1899. Increase over unfertilized plots.	1900. Yield seed cotton per acre.	1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal......	480	216	348	—60
2	240	Acid phosphate	556	292	456	48
3	00	No fertilizer...........	264	....	408	....
4	200	Kainit................	280	27	528	128
5	200 240	Cotton seed meal.... Acid phosphate	768	526	492	100
6	200 200	Cotton seed meal.... Kainit	524	293	588	204
7	240 200	Acid phosphate....... Kainit..............	684	465	476	100
8	00	No fertilizer..........	208	....	368	....
9	200 240 200	Cotton seed meal. .. Acid phosphate...... Kainit..............	828	620	648	280
10	200 240 100	Cotton seed meal.... Acid phosphate...... Kainit	944	736	532	164

The following figures refer only to the results obtained in 1900, similar statement for other years having been previously published:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot ....—60 lbs.
To acid phosphate plot .... 52 lbs.
To kainit plot .... 76 lbs.
To acid phosphate and kainit plot ....180 lbs.

Average increase with cotton seed meal......... 62 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	48 lbs.
To cotton seed meal plot	160 lbs.
To kainit plot	—28 lbs.
To cotton seed meal and kainit plot	76 lbs.
Average increase with acid phosphate	**64 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	128 lbs.
To cotton seed meal plot	264 lbs.
To acid phosphate plot	52 lbs.
To cotton seed meal and acid phosphate plot	180 lbs.
Average increase with kainit	**155 lbs.**

EXPERIMENT MADE BY C. E. RIVERS, 6½ MILES S. OF HURTSBORO, RUSSELL COUNTY.

Dark sandy soil, with yellow subsoil.

This test was made in 1900 on flat land that might be designated as second bottom.

The land had been cleared about 40 years ago of its original growth of long leaf pine, but for many years before the experiment began it had been uncultivated and had grown up in broomsedge. The date of planting was late and it was noted that many bolls, especially on Plots 9 and 10, did not mature.

Phosphate under all conditions was highly profitable. The average increase with cotton meal was not quite sufficient to yield a profit; this poor showing of cotton seed meal is probably due to the fact that considerable vegetable matter and nitrogen must have accumulated on the land while it was uncultivated. On fields in

constant cultivation some cotton seed meal would doubtless have been profitable. Kainit was slightly helpful and as a part of a complete fertilizer, containing all three materials, kainit paid a fair profit.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	154 lbs.
To acid phosphate plot	30 lbs.
To kainit plot	14 lbs.
To acid phosphate and kainit plot	27 lbs.
Average increase with cotton seed meal	**56 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	240 lbs.
To cotton seed meal plot	116 lbs.
To kainit plot	274 lbs.
To cotton seed meal and kainit plot	287 lbs.
Average increase with acid phosphate	**229 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	83 lbs.
To cotton seed meal plot	—57 lbs.
To acid phosphate plot	117 lbs.
To cotton seed meal and acid phosphate plot	114 lbs.
Average increase with kainit	**64 lbs.**

EXPERIMENT MADE IN 1899 BY A. M. TROYER, ¾ OF A MILE N. OF CALHOUN, LOWNDES COUNTY.

The soil is described as a loam fairly retentive of water and as being of a very light reddish color, with bright red subsoil. The second growth of trees, removed about 5 years ago, was short leaf and old field pine. In 1896

and 1897 this field was not cultivated, and in 1898 the crop was oats.

Under all conditions acid phosphate was highly profitable, the average increase attributable to phosphate being 434 pounds per acre. Cotton seed meal was generally profitable, but not to the same extent as phosphate. Kainit was not needed. By far the larger profit was obtained on the plot containing both acid phosphate and cotton seed meal.

Mr. Troyer also conducted an experiment in 1900 on similar soil, the results of which were entirely inconclusive. They may be found in the table on page 52.

In 1900 he also tested the most promising combinations of fertilizers on an adjoining farm, on very sandy soil.

The fertilizer for this last test was not furnished by the Experiment Station and a detailed report of the amounts of fertilizer used is not at hand.

The following is Mr. Troyer's statement of the increase in yield in 1900 on his sandy soil, where the unfertilized land yielded 384 pounds of seed cotton per acre:

	Increase per acre in lbs. seed cotton.	Net profit.
Cotton seed meal	144	$2.40
Acid phosphate	48	.16
Kainit	112	2.88
Cotton seed meal and phosphate	176	1.76
Cotton seed meal, phosphate and kainit	320	5.28

Apparently on this sandier soil a complete fertilizer was needed, kainit, as well as other materials, yielding a profit.

The increased yields obtained in the experiment at Calhoun in 1899 are given below:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	312 lbs.
To acid phosphate plot	267 lbs.
To kainit plot	187 lbs.
To acid phosphate and kainit plot	—138 lbs.
Average increase with cotton seed meal	**157 lbs.**

Increase of seed cotton per acre when acid phosphate was added.

To unfertilized plot	482 lbs.
To cotton seed meal plot	437 lbs.
To kainit plot	571 lbs.
To cotton seed meal and kainit plot	246 lbs.
Average increase with acid phosphate	**434 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	107 lbs.
To cotton seed meal plot	—18 lbs.
To acid phosphate plot	196 lbs.
To cotton seed meal and acid phosphate plot	—209 lbs.
Average increase with kainit	**19 lbs.**

Experiment made by W. C. Bevill in 1899 near Naheola, Choctaw County.

This experiment was made on upland soil of a "dark mulatto" color, with red clay subsoil. The three preceding crops were cotton. The field had been cleared about 50 years and the original growth is reported as long leaf pine, short leaf pine, oak, and gum.

There was no rust or other injury except from severe

drought, which reduced the yield to about half a crop, and which probably makes the experiment nearly valueless as an indication of the needs of the cotton plant on this soil in normal seasons.

Under the conditions of this test no fertilizer was very effective, though the increase with cotton seed meal was sufficient to pay a small profit.

Mr. Bevill conducted an experiment in 1898 on what appeared to be similar soil. In that year cotton seed meal gave a large increase in yield, phosphate a smaller though profitable increment, and kainit an increase barely sufficient to afford a small profit. In 1898 as well as in 1899 unfavorable weather vitiated the experiment, and it is doubtful whether the results for either year show the full effect that any of the three fertilizers would exert in normal seasons.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	56 lbs.
To acid phosphate plot	178 lbs.
To kainit plot	114 lbs.
To acid phosphate and kainit plot	172 lbs.
Average increase with cotton seed meal	**130 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	32 lbs.
To cotton seed meal plot	154 lbs.
To kainit plot	—25 lbs.
To cotton seed meal and kainit plot	33 lbs.
Average increase with acid phosphate	**49 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ..	13 lbs.
To cotton seed meal plot	71 lbs.
To acid phosphate plot	—44 lbs.
To cotton seed meal and acid phosphate plot...	—50 lbs.
Average increase with kainit	**—3 lbs.**

Experiment made on the farm of the South East Alabama Agricultural School, Jackson, Clarke County.

Stiff, dark red, or "mulatto" soil; subsoil, red clay.

The experiment of 1899 was conducted by J. L. Ballard, that of 1900 by Prof. J. W. Culver. The field consisted of upland, cleared at least 10 years before the experiment began of its growth of long leaf and short leaf pine and oak. The land used for the experiment of 1900 had been pastured for two years. No report was made of crops preceding the experiment of 1900.

The results of the two experiments may be found in the table on page 42 and in the analysis of that table given below.

In 1899 phosphate was by far the most effective fertilizer, though both cotton seed meal and kainit, as well as phosphate, were profitable when employed in a complete fertilizer.

In 1900, on ground not fertilized for several years previous to the experiment, all three fertilizing materials were exceedingly effective, all being of practically equal importance. This soil is unusually responsive to commercial fertilizers. A complete fertilizer afforded much the largest profit, both in 1899 and 1900.

Increase of seed cotton per acre when seed meal was added:

	1899.	1900.
To unfertilized plot	136 lbs.	112 lbs.
To acid phosphate plot	—90 lbs.	179 lbs.
To kainit plot	—146 lbs.	356 lbs.
To acid prosphate and kainit plot	500 lbs.	855 lbs.
Average increase with cotton seed meal,	**103 lbs.**	**376 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	336 lbs.	176 lbs.
To cotton seed meal plot	110 lbs.	243 lbs.
To kainit plot	—7 lbs.	234 lbs.
To cotton seed meal and kainit plot	639 lbs.	733 lbs.
Average increase with acid phosphate,	**269 lbs.**	**347 lbs.**

Increase of seed cotton per acre when kainit was used:

To unfertilized plot	115 lbs.	79 lbs.
To cotton seed meal plot	—167 lbs.	323 lbs.
To acid phosphate plot	—228 lbs.	137 lbs.
To cotton seed meal and acid phosphate plot	362 lbs.	813 lbs.
Average increase with kainit	**21 lbs.**	**334 lbs.**

Several experiments had been made previously on this farm. That of 1898 showed acid phosphate to be the most valuable single fertilizer, but that both kainit and cotton seed meal afforded such an increase as to make the complete fertilizer—which contained all three—the most profitable of all applications.

In 1897, when drought prevailed, only cotton seed meal was very effective.

Clearly a complete fertilizer is profitable on this soil, which lends itself readily to intensive farming.

Hurtsboro, Calhoun, Naheola and Jackson experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Hurtsboro. 1900. Yield seed cotton per acre.	Hurtsboro. 1900. Increase over unfertilized plots.	Calhoun. 1899. Yield seed cotton per acre.	Calhoun. 1899. Increase over unfertilized plots.	Naheola. 1899. Yield seed cotton per acre.	Naheola. 1899. Increase over unfertilized plots.	Jackson. 1899. Yield seed cotton per acre.	Jackson. 1899. Increase over unfertilized plots.	Jackson. 1900. Yield seed cotton per acre.	Jackson. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*
1	200	Cotton seed meal	512	154	548*	312*	536	56	960	136	552	112
2	240	Acid phosphate	648	240	718*	482*	512	32	1160	336	616	176
3	00	No fertilizer	368	....	236*	...	480	.....	824	....	440	....
4	200	Kainit	440	83	366	107	520	13	968	115	520	79
5	200	Cotton seed meal	616	270	1030	749	744	310	1128	246	808	355
	240	Acid phosphate										
6	200	Cotton seed meal	432	97	598	294	688	127	880	—31	880	435
	200	Kainit										
7	240	Acid phosphate	680	357	904	678	576	—12	1048	108	760	313
	200	Kainit										
8	00	No fertilizer	312	....	350	. .	616	....	968	....	448	....
9	200	Cotton seed meal	696	384	890	540	776	160	1576	608	1616	1168
	240	Acid phosphate										
	200	Kainit										
10	200	Cotton seed meal	720	408	780*	430*	800	184	1440	472	1520	1072
	240	Acid phosphate										
	100	Kainit										

* Defective stand.

Experiments made by G. S. McClure, 2 miles east of Garland, Butler County.

Gray sandy land, with stiffer yellowish subsoil at depth of 6 inches.

The experiment in 1899 was made in a field cleared about 1880 and continuously in cultivation during each of the past six years. The test in 1900 was conducted on land that had been cleared about twelve years. The original growth was long-leaf pine, with a few black-jack oaks.

In both experiments oats was the preceding crop. There was practically no injury from "black rust" in 1900. In 1899 this disease caused considerable loss on Plot 2 and a smaller amount on plots 5 and 3, with practically no injury on other parts of the experiment.

The table on page 48 and the analysis of that table given below show the yield and amount of increase attributable to the fertilizers.

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	272 lbs.	96 lbs.
To acid phosphate plot	492 lbs.	336 lbs.
To kainit plot	252 lbs.	168 lbs.
To acid phosphate and kainit plot	40 lbs.	344 lbs.
Average increase wilh cotton seed meal,	**264 lbs.**	**236 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	152 lbs.	160 lbs.
To cotton seed meal plot	372 lbs.	400 lbs.
To cotton seed meal and kainit plot	154 lbs.	208 lbs.
Average increase with acid phosphate.	**261 lbs.**	**200 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	226 lbs.	48 lbs.
To cotton seed meal plot	206 lbs.	120 lbs.
To acid phosphate plot	440 lbs.	—80 lbs.
To cotton seed meal and acid phosphate plot	—12 lbs.	—72 lbs.
Average increase with kainit	**216 lbs.**	**—4 lbs.**

In both years the most profitable fertilizer was a mixture of acid phosphate and cotton seed meal. Both cotton seed meal and acid phosphate, whether applied alone, or in combination, were highly profitable. Kainit had no beneficial effect in the presence of a mixture of phosphate and cotton seed meal, but in 1899, kainit was quite effective when used alone or in combination with either one (but not both) of the other materials; this was the season when rust was injurious on certain plots receiving no kainit.

Two experiments made in the same region by G. O. Sellans, at Lumber Mills, (see Bulletin No. 102) accord with Mr. McClure's experiments in showing that these soils are highly responsive to acid phosphate and cotton seed meal and that kainit is decidedly beneficial only in seasons when black rust is severe.

Experiment made in 1899 by C. H. Mason, ½ mile N. of Wilson, Escambia County.

Light sandy loam; with red clay subsoil.

This field of upland was cleared of its growth of long-leaf pine two years before the beginning of the test and during these two years the land was occupied by cow-peas, presumably grown for hay.

For yields of cotton seed see the table on page 48.

The following analysis shows that the one conspicuous need of this fresh land was for phosphate. The indifference of this particular field towards cotton seed meal is due to the recent clearing and to the two preceding crops of peas, both of which conditions imply the presence of considerable nitrogen in the soil. The soils of this region after a few years cultivation usually respond profitable to both phosphate and cotton seed meal, and some of them to kainit. A test made at Wilson on "new ground" in 1898 by J. H. Wilcox, gave results similar to those obtained in this experiment.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	200 lbs.
To acid phosphate plot	—112 lbs.
To kainit plot	24 lbs.
To acid phosphate and kainit plot	208 lbs.
Average increase with cotton seed meal	**108 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	632 lbs.
To cotton seed meal plot	320 lbs.
To kainit plot	328 lbs.
To cotton seed meal and kainit plot	512 lbs.
Average increase with acid phosphate	**448 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	8 lbs.
To cotton seed meal plot	—168 lbs.
To acid phosphate plot	—292 lbs.
To cotton seed meal and acid phosphate plot	24 lbs.
Average *decrease* **with kainit**	**107 lbs.**

EXPERIMENTS MADE IN 1899 AND 1900 BY T. M. BORLAND, ½ MILE S. W. OF DOTHAN, HENRY COUNTY.

Gray sandy land; subsoil yellowish.

The land was cleared of the original growth of long leaf pine nearly 10 years ago. In both cases the preceding crop was corn. Mr. Borland writes that peanuts were grown in 1899 between the corn rows on the area where the cotton experiment of 1900 was conducted.

Very hot dry weather in the latter part of the summer of 1899, and lice and excessive rafall in 1900 damaged the crop. The experimenter reports that rust was absent.

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot	248 lbs.	56 lbs.
To acid phosphate plot	110 lbs.	20 lbs.
To kainit plot	119 lbs.	93 lbs.
To acid phosphate and kainit plot	123 lbs.	81 lbs.
Average increase with cotton seed meal,	**150 lbs.**	**63 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	208 lbs.	208 lbs.
To cotton seed meal plot	70 lbs.	172 lbs.
To kainit plot	227 lbs.	30 lbs.
To cotton seed meal and kainit plot	231 lbs.	18 lbs.
Average increase with acid phosphate,	**184 lbs.**	**107 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	106 lbs.	201 lbs.
To cotton seed meal plot	—23 lbs.	238 lbs.
To acid phosphate plot	125 lbs.	23 lbs.
To cotton seed meal and acid phosphate plot	138 lbs.	84 lbs.
Average increase with kainit,	**87 lbs.**	**139 lbs.**

In both experiments a complete fertilizer afforded the largest increase in yield. A showing almost as favorable was made by the mixture of cotton seed meal and kainit.

The slight benefit from cotton seed meal in 1900 is probably due to the fact that peanuts were grown between the corn rows the year before. The experiment of 1900 makes the fourth test of fertilizers on cotton made on this farm. All these results point toward the need of all three of the fertilizer materials tested, kainit giving the largest average increase for the four years, viz.: 168 pounds of seed cotton per acre per annum. A similar average shows the increase with cotton seed meal to be 134 pounds, and with phosphate to be 122 pounds.

It is not surprising that this land, which has been in cultivation less than 10 years should be less responsive to cotton seed meal than are most of the soils of regions that were settled earlier. It also seems less responsive to phosphate and more so to kainit than do most of the soils on which tests have been made.

Garland, Wilson and Dothan experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Garland. 1899. Yield seed cotton per acre.	Garland. 1899. Increase over unfertilized plots.	Garland. 1900. Yield seed cotton per acre.	Garland. 1900. Increase over unfertilized plots.	Wilson. 1899. Yield seed cotton per acre.	Wilson. 1899. Increase over unfertilized plots.	Dothan. 1899. Yield seed cotton per acre.	Dothan. 1899. Increase over unfertilized plots.	Dothan. 1900. Yield seed cotton per acre.	Dothan. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lcs.*	*Lbs.*
1	200	Cotton seed meal	664	272	504	96	280	200	840	248	424	56
2	240	Acid phosphate	544	152	568	160	712	632	800	208	576	208
3	00	No fertilizer	392	......	408	......	80	....	592	.....	368	......
4	200	Kainit	640	226	448	48	88	8	696	106	552	201
5	200 240	Cotton seed meal Acid phosphate	1080	644	888	496	600	520	904	318	560	228
6	200 200	Cotton seed meal Kainit	936	478	600	216	112	32	808	225	608	294
7	240 200	Acid phosphate Kainit	1072	592	456	80	416	336	912	333	528	281
8	00	No fertilizer	512	......	368	......	80	.....	576	.....	280	......
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1144	632	792	424	624	544	1032	456	592	312
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1176	664	736	358	728	648	920	344	472	192

Inconclusive Experiments.

The three following tables give the yields obtained in tests that were altogether inconclusive:

The list on page 3 gives the names of the parties making the experiments at each of the localities referred to in the three tables that follow. In the case of some of these tests suggestions of value may reward a careful examination of the figures, but usually want of uniformity in the soil selected, or other vitiating condition, entirely destroys the worth of the experiments here tabulated.

Tuscumbia, Boligee, Berney and Hamilton experiments with cotton.

Plot No.	Fertilizers. Amount per acre	Fertilizers. Kind.	Boligee. 1899 Yield seed cotton per acre.	Boligee. 1899 Increase over unfertilized plots.	Berney's. 1899. Yield seed cotton per acre.	Berney's. 1899. Increase over unfertilized plots.	Berney's. 1900. Yield seed cotton per acre.	Berney's. 1900. Increase over unfertilized plots.	Hamilton. 1900. Yield seed cotton per acre.	Hamilton. 1900. Increase over unfertilized plots.	Tuscumbia. 1899. Yield seed cotton per acre.	Tuscumbia. 1899. Increase over unfertilized plots.	Tuscumbia. 1900. Yield seed cotton per acre.	Tuscumbia. 1900. Increase over unfertilized plots.
	Lbs		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	832	296	368	72	568	40	562	136	752	184	600	240
2	240	Acid phosphate	610	104	368	72	552	24	600	184	728	160	536	176
3	00	No fertilizer	536	....	296	....	528	.....	416	.....	568	......	360	......
4	200	Kainit	512	—16	418	155	575	49	568	125	784	252	296	—24
5	200 240	Cotton seed meal Acid phosphate	640	120	418	200	968	443	680	210	568	71	312	30
6	200 200	Cotton seed meal Kainit	632	120	480	197	704	181	668	171	410	—22	272	28
7	240 200	Acid phosphate Kainit	528	24	560	283	760	239	808	283	456	28	264	60
8	00	No fertilizer	496	......	272	....	520	.....	552	....	392	....	168	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	448	—48	461	192	624	104	808	256	352	—40	480	312
10	200 240 100	Cotton seed meal Acid phosphate Kainit	278	—208	432	160	560	40	818	266	544	152	432	264

Sterrett, Dillburg, Marvyn, Oak Bowery and Greensboro experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Sterrett. 1899. Yield seed cotton per acre.	Sterrett. 1899. Increase over unfertilized plots.	Sterrett. 1900. Yield seed cotton per acre.	Sterrett. 1900. Increase over unfertilized plots	Dillburg. 1900. Yield seed cotton per acre.	Dillburg. 1900. Increase over unfertilized plots.	Marvyn. 1899. Yield cotton seed per acre.	Marvyn. 1899. Increase over unfertilized plots.	Oak Bowery. 1900. Yield seed cotton per acre.	Oak Bowery. 1900. Increase over unfertilized plots.	Greensboro. 1899. Yield seed cotton per acre.	Greensboro. 1899. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	752	328	928	—184	976	508	376	86	120	—160	392	—24
2	240	Acid phosphate	640	216	1128	16	872	504	264	—16	240	00	584	168
3	00	No fertilizer	424	......	1112	......	......	......	280	......	280	.....	416	....
4	200	Kainit	528	82	1120	00	568	200	472	170	368	95	576	106
5	200	Cotton seed meal	744	275	1128	199	816	448	400	75	384	117	668	285
	240	Acid phosphate												
6	200	Cotton seed meal	712	221	1056	218	816	448	432	85	416	156	720	323
	200	Kainit												
7	240	Acid phosphate	760	246	840	93	656	288	360	—10	408	154	504	114
	200	Kainit												
8	00	No fertilizer	536	......	656	.....	368	.....	392	......	248	.....	284	.....
9	200	Cotton seed meal	768	282	936	280	856	488	584	192	400	152	520	136
	240	Acid phosphate												
	200	Kainit												
10	200	Cotton seed meal	760	224	912	256	680	312	688	296	240	—8	536	152
	240	Acid phosphate												
	100	Kainit												

Calhoun, Greenville, Evergreen, Union Springs and Abbeville experiments with cotton.

Plot No.	Fertilizers. Amount per acre.	Fertilizers. Kind.	Calhoun. 1900. Yield seed cotton per acre.	Calhoun. 1900. Increase over unfertilized plots.	Greenville 1900. Yield seed cotton per acre.	Greenville 1900. Increase over unfertilized plots.	Evergreen. 1899. Yield seed cotton per acre.	Evergreen. 1899. Increase over unfertilized plots.	Union Springs. 1899. Yield seed cotton per acre.	Union Springs. 1899. Increase over unfertilized plots.	Abbeville. 1899. Yield seed cotton per acre.	Abbeville. 1899. Increase over unfertilized plots.	Abbeville. 1900. Yield seed cotton per acre.	Abbeville. 1900. Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	414	80	1016	563	882	270	576	152	760	320	276	152
2	240	Acid phosphate	300	—64	968	520	764	152	444	20	656	216	184	40
3	00	No fertilizer	364	.....	....	....	612	.....	424	.....	440	....	144	...
4	200	Kainit	408	—7	960	512	808	196	.....	.....	552	137	208	27
5	200	Cotton seed meal	256	—210	1144	696	840	228	912	376	634	274	456	237
	240	Acid phosphate												
6	200	Cotton s ed meal	640	123	848	400	896	284	496	—96	640	276	469	211
	240	Kainit												
7	240	Acid phosphate	664	96	576	128	1016*	404*	568	—80	416	79	363	71
	200	Kainit												
8	00	No fertilizer	620	.....	448	.....	904*	.....	701	.....	312	....	336	....
9	200	Cotton seed meal	624	4	880	432	1420*	516*	776	72	584	272	608	272
	240	Acid phosphate												
	200	Kainit												
10	200	Cotton seed meal	644	24	768	320	1376*	462*	914	240	712	400	568	232
	240	Acid phosphate												
	100	Kainit												

* Not comparable with Plots 1—6, being in different part of field.

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ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Feeding Experiment with Dairy Cows.

By J. F. DUGGAR AND R. W. CLARK.

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Feeding Experiments with Dairy Cows.

By J. F. Duggar and R. W. Clark.

Summary.

With cotton seed at $8 per ton, cotton seed meal at $20, cotton seed hulls at $4, and sorghum hay at $6.67, butter was produced at a lower cost per pound on a ration consisting chiefly of raw cotton seed and hay than on one made up principally of cotton seed meal and hulls.

The cows did not greatly relish cotton seed and hence ate less than was desirable of the ration containing this; hence on the larger amounts eaten the oil mill ration afforded a larger daily yield of both milk and butter than did the farm-grown ration.

In two experiments the average daily amount of milk per cow was 17.5 pounds from the cotton seed ration and 24.3 pounds from the cotton seed meal ration; the daily production of butter per cow averaged .93 of a pound with the cotton seed and 1.19 with the oil mill ration, this being an increase of 38 per cent in milk and 28 per cent in butter. Nevertheless the low cost of the cotton seed ration made it the more economical, the average cost of the food required to make a pound of butter being only 10.4 cents when this ration was given and 15.3 cents when the hulls and meal ration was employed.

On account of the larger amounts of food consumed, the cows while receiving the cotton seed meal ration gained nearly half a pound a day in weight, while the cows eating cotton seed in smaller amounts lost .8 of a pound per day.

The cheapest butter was made by a Jersey heifer with her first calf, the food to make one pound of butter costing in this case only 6.4 cents when cotton seed was fed and 11.2 cents when cotton seed meal was given.

The manure (liquid and solid) dropped during the 16 hours of each day which the cows passed in the barn was carefully saved, analyzed, and applied to various crops.

The amount of manure, including sawdust bedding, per cow per night (of 16 hours) averaged 33.9 pounds when cotton seed was fed and 48.3 pounds when cotton seed meal was fed.

The manure made from the cotton seed and sorghum hay ration contained 10.7 pounds of nitrogen per ton; that from cotton seed meal and hulls contained 16.6 pounds, an increase of 55 per cent. in the amount of nitrogen per ton.

In percentages of phosphoric acid and potash the two manures were practically identical.

For one or two days the cows were kept stabled during the entire 24 hours and the amount of manure thus obtained (exclusive of bedding) was about double the amount secured by stabling the cows for 16 hours per day.

About one-half the manure was dropped out of doors.

Green rye at the rate of 52 to 54 pounds per day proved a satisfactory substitute for either sorghum hay or cotton seed hulls.

While the cows ate green rye the amount of milk slightly increased but the milk was slightly poorer than during the preceding period when only dry food was consumed.

An upland corn field from which the ears had been harvested, and in which cowpeas had been drilled between the corn rows, was grazed first by milk cows and

later by dry cows, the milk cows meantime receiving 3 pounds of cotton seed meal per day.

On this pasturage the yield of milk was 15.8 per cent greater and of butter 9.5 per cent greater than when the cows with the same grain feed ran on a good pasture of bermuda grass, carpet grass, lespedeza, etc.

The value of the product of butter and of the increase in live weight of the cows averaged $4.47 per acre of corn and pea field grazed, after deducting the cost of the cotton seed meal fed at the same time.

INTRODUCTORY.

Under some conditions it is practicable for the dairyman to purchase a considerable proportion of the food which his cows consume. However, the temptation is to rely to too great an extent on purchased foods. These can be profitably used to a certain extent but rather as supplements to foods produced on the farm than as substitutes for farm-grown food. It is believed that any marked development of dairying and of beef production in the South is conditioned on the increased reliance on the foods which the fields and pastures produce. The feeder who buys thin cattle at a low price and, after a few months feeding, sells them at a higher price per pound, relies almost wholly upon cotton seed meal and hulls, but the stock raiser cannot afford to make the oil mill his principal depot of supplies.

Bearing in mind this necessity for avoiding large expenditures for purchased foods, we have planned a line of experiments intended to ascertain the extent to which farm-grown foods can be relied on in the feeding of dairy cows and the best crops for use as food in effecting this end.

The first experiments here reported are preliminary to this investigation and involve a comparison of a ration

made up chiefly of the most economical of all purchased foodstuffs, cotton seed meal and hulls, with one consisting chiefly of cotton seed and sorghum hay, both of which latter materials can be grown on every farm in the cotton belt.

PURCHASED VS. FARM-GROWN RATION IN 1900.

The farm-grown ration consisted of cotton seed and sorghum hay, with small amounts of wheat bran and corn meal added to improve the palatability and to increase the amount of cotton seed consumed. The endeavor was to make each cow eat daily at least 9 pounds raw cotton seed, 10 pounds sorghum hay, 3 pounds wheat bran, and 3 pounds corn meal; and the foods were mixed in these proportions. As much of the mixture was given to each cow as she would eat clean.

The purchased, or "oil mill" ration consisted of a mixture of 5.25 pounds of cotton seed meal, 10 pounds of cotton seed hulls, 3 pounds of wheat bran, and 3 pounds of corn meal. This mixture was also fed in amounts as large as the cows would eat and the quantity consumed was greater than had been expected when the experiment was planned.

The following prices for food stuffs used in calculating the cost of butter are assumed as average prices in this State for a series of years, except that sorghum hay, for which there is no market, is charged at a price somewhat above its average cost of production:

Cotton seed	$ 8.00	per ton.
Cotton seed meal	20.00	per ton.
Cotton seed hulls	4.00	per ton.
Wheat bran	18.00	per ton.
Corn meal	20.00	per ton.
Sorghum hay	6.67	per ton.

The cows used were as follows:

Name.	Breed.	Age.	Day sinces calving.	Weight when test began.
				Lbs.
Ada..........	Jersey......	8 years..	110	816
Queen........	Holstein....	8½ years..	81	980
Rozena.......	Holstein ...	8½ years..	119	1150
Hypatia......	Jersey..	4 years..	19	788
Annie.....	Jersey	10 years..	80	762

The experiment was divided into two periods of four weeks each, each period being preceded by a preparatory period of one week during which the cows were accustomed to the food which they were to receive during the next period.

During the first period Ada and Queen received the cotton seed ration, Rozena and Annie meantime getting the ration of cotton seed meal and hulls. During the second period the rations were reversed, so that each lot of cows was fed for one whole period on each kind of food. Annie refused the cotton seed ration and hence in the second period it was necessary to substitute Hypatia.

Composite samples of the milk were tested weekly by the Babcock test and the amount of fat thus found was converted into butter by the usual method of multiplying by one and one-sixth.

Amount, kind and cost of food eaten.

Period. (each 28 days.)	Cow.	Pounds food in 28 days. Cotton seed.	Sorghum hay.	Cotton seed meal.	C. S. hulls.	Wheat bran	Corn meal.	Cost of food. In 28 days.	Per day.
									Cents.
I	*Jan. 16 to Feb. 12.*								
I	Ada....	287	286	......	......	95	95		
I	Queen..	246	233	......	......	72	72		
II	*Feb. 23 to Mar. 22.*								
II	Rozena.	290	270	......	......	97	97		
II	Hypatia	193	212	......	......	64	64		
Total,	4 cows...	1016	1001	......	......	328	328	$13.57	12.1
II	Ada......	......	......	220	419	125	125		
II	Queen...	......	......	248	467	140	140		
I	Rozena...	......	......	251	478	143	143		
I	Annie...	......	......	161	307	92	92		
Total,	4 cows...	......	......	878	1673	500	500	$21.63	19.3

The cows receiving the "oil mill" ration ate much more heartily than the others, the cotton seed making the "farm-grown" ration relatively unpalateable. The amounts eaten daily per head were as follows, taking the average for four cows on each food:

	Lbs.		Lbs.
Cotton seed, raw......	9,07	Cotton seed meal .	7.83
Wheat bran	2.93	Wheat bran	4.38
Corn meal	2.93	Corn meal	4.38
Total concentrates..	14.93	Total concentr't's.	16.59
Sorghum hay	9.10	Cotton hulls	14.90
Total food	24.03	Total food.....	31.49

The average daily cost of food per day was 12.1 cents per cow with the farm-grown ration and 19.3 with the oil mill ration.

While it cost much more to feed the cows on the purchased ration, we may not pronounce this the least economical ration until we have noted the amount of butter produced by each.

Milk and butter produced by feeding a ration consisting largely of cotton seed and sorghum hay vs. one containing cotton seed meal and hulls.

Cotton seed and hay ration.				Cotton seed meal and hulls ration.			
Period.	Cow.	Milk.	Butter.	Period.	Cow.	Milk.	Butter.
		Lbs.	*Lbs.*			*Lbs.*	*Lbs.*
I	Ada..........	582.1	24.36	II	Ada...........	639.0	29.90
I	Queen.	586.0	27.76	II	Queen.	914.1	36.30
II	Rozena.......	638.3	29.00	I	Rozena........	1179 5	46.16
II	Hypatia......	514.7	28.60	I	Annie.........	639.1	34.90
Total,	4 cows, 28 days	2321.1	109.62	Total,	4 cows, 28 days	3371.7	147.26
Av.	Per cow, per day.........	20.7	.98	Av.	Per cow per day	29.6	1.31

The product obtained was greater with the oil mill ration, the increase in milk being 43 per cent and in butter 34 per cent. This increased production of milk and butter with the purchased ration is due largely, if not entirely, to the larger quantities of food consumed.

If we take 20 cents per pound as the value of the butter and assume that the manure and skim milk have sufficient value to pay for the labor of caring for the cows and making the butter, we have the following statement of the cost and profit on butter.

Financial statement.

	With farm grown ration.	With oil mill ration.
Value of butter from 4 cows, 28 days.........	$21.92	29.56
Cost of food, 4 cows, 28 days....................	13.57	21.63
Profit from 4 cows, 28 days	8.35	7.93
Cost of food per pound of butter, cents........	12.1	15.2
Daily profit per cow, cents.......	7.5	7.1
Profit per pound of butter. cents...............	7.9	4.8

The butter was produced at a cost of 12.1 cents per pound when the cotton seed and hay ration was fed and of 15.2 cents per day when cotton hulls and meal were fed in maximum amounts. Yet the daily production was so much larger on the last mentioned ration that the average daily profit per cow is nearly the same with both rations, viz. 7.5 cents with farm foods and 7.1 cents with oil mill products.

SECOND EXPERIMENT; PURCHASED VS. FARM-GROWN RATION IN 1901.

In January and February 1901 the experiment of the preceding winter was repeated, with slight modifications in the rations.

The foods were mixed in the following proportions, and the cows were allowed to eat as much of each mixture as they would.

Farm grown ration.	*Purchased ration.*
9 lbs. raw cotton seed.	5.25 lbs. cotton seed meal.
3 lbs. wheat bran.	3 lbs. wheat bran.
10 lbs. sorghum hay.	10 lbs. cotton seed hulls.

Prices used in calculating the cost of butter are the same as in the former experiment.

The experiment extended over a similar period of time, two periods of 28 days each, both preceded by a week of

preparatory feeding. The first period extended from January 1 to 28, 1901, the second from February 5 to March 4 inclusive.

Lot 1 consisted of two cows, and Lot II of three cows. The different number of cows in the two lots does not affect the accuracy of the results, for at the conclusion of the first period the rations were reversed, thus making each cow at different times during the experiment consume both rations.

The cows employed were as follows:

	Breed.	Age. Years.	Days since calving.	Weight when test began.
Ida	Jersey	5	110	810
Hypatia	do	5	16	740
Annie	do	11	87	795
Ada	do	9	48	830
Susan	do	3 (1st calf)	141	610

Amount, kind, and cost of food eaten.

Period.	Cow.	Lbs. food in 28 days.					Cost of food.	
		Cotton seed.	Sorghum hay.	Cotton seed meal.	Cotton seed hulls.	Wheat bran	In 28 days.	Per day.
								Cents.
I	Ida	258	207			86		
I	Hypatia	275	242			92		
II	Annie	175	135			58		
II	Ada	200	180			66		
II	Susan	168	162			56		
Total,	5 cows	1076	926			358	$10.61	7.5
II	Ida			235	449	134		
II	Hypatia			272	519	155		
I	Annie			193	368	110		
I	Ada			256	490	147		
I	Susan			189	360	108		
Total,	5 cows			1144	2186	654	$21.60	15.4

As in the former experiment we were unable to induce the cows to eat the desired amount of the cotton seed ration.

The food consumed per head daily averaged as follows:

	Lbs.		Lbs.
Cotton seed, raw ...	7.68	Cotton seed meal...	8.17
Wheat bran	2.56	Wheat bran	4.66
Total concentrates..	10.24	Total concentrates..	13.83
Sorghum hay	6.61	Cotton seed hulls...	15.60
Total food	16.85	Total food	29.43

The average daily cost of food was 7.5 cents per cow with the farm-grown ration and 15.4 cents with the oil mill ration. However, the more expensive ration gave the larger product, as appears below:

Milk and butter produced by feeding in 1901 a ration consisting largely of cotton seed and sorghum hay versus one containing cotton seed meal and hulls.

Cotton seed and hay ration.				Cotton seed meal and hulls ration.			
Period.	Cow.	Milk.	Butter.	Period.	Cow.	Milk.	Butter.
		Lbs.	*Lbs.*			*Lbs.*	*Lbs.*
I	Ida..........	359.2	21.09	II	Ida..........	523.8	29.00
I	Hypatia.....	532.7	30.44	II	Hypatia.....	640.3	26.78
II	Annie.......	380.9	22.42	I	Annie.......	607.8	32.22
II	Ada	409.5	22.70	I	Ada.........	549.2	28.79
II	Susan.......	318.6	26.39	I	Susan.......	446.3	31.76
Total...	5 cows,28 d'ys	2000.9	123.04	Total...	5 cows,28 d'ys	2767.4	148.50
Av. per	cow per day	14.86	.88	Av. per	cow per day	19.0	1.06

The purchased ration afforded an increase over the farm-grown ration of 32 per cent. in milk and 21 per cent in butter. Of course this increase must be attrib-

uted chiefly to the fact that larger amount of the former were consumed on account of its greater palateability.

With butter at 20 cents per pound and food stuffs at same prices as in the former experiment we obtain the following:

Financial Statement.

	With farm-grown ration.	With oil mill ration.
Value of butter from 5 cows, 28 days.	$24.61	$29.70
Cost of food, 5 cows, 28 "	10.61	21.60
Profit from 5 cows, 28 "	14.00	8.10
Cost of food per pound of butter, cents.	8.6	15.4
Daily profit per cow, cents	10.0	5.8
Profit per pound of butter, cents	11.4	4 6

The farm-grown ration afforded a greater profit whether we use as a basis the daily profit per cow or the profit on each pound of butter; this latter profit was 11.4 cents when the cotton seed ration was fed and 4.6 cent when the meal and hulls ration was employed.

Attention is called to the excellent record made by the Jersey heifer Susan.

Although she had calved nearly five months before her experimental feeding began, yet she averaged 1.14 pounds of butter per day during the 28 days while receiving cotton seed meal.

AVERAGE RESULTS OF THE TWO EXPERIMENTS.

Taking the averages of the figures in the two experiment we find:

	With cotton seed ration. Cents.	With oil mill ration. Cents.
Cost of food per pound of butter........	10.35	15.3
Daily profit per cow	8.75	6.45
Daily production of butter per cow, lbs...	.93	1.19
Daily production of milk per cow, lbs...	17.53	24.3

With the oil mill ration the daily production of butter was larger by 28 per cent and the daily flow of milk by 38 per cent. But the amount of food consumed, and hence the daily cost, was so much greater than with the farm-grown ration that the latter was decidedly more profitable.

Effects of rations on weight and health of cows.

Effect of food on live weight.

	Period beginning.	Weight at beginning.	Weight at end of period.	Gain (+) or loss (—) in 28 days. On farm ration.	Gain (+) or loss (—) in 28 days. On oil mill ration.
Ada	Jan. 16, 1900	816	832	+ 16	
Queen	do	980	970	— 10	
Ada	Feb. 23, 1900	862	861	....	— 1
Queen	do	1003	1072	....	+ 69
Rozena	Jan. 16, 1900	1150	1175	....	+ 25
*Annie	do	762	775	....	+ 13
Rozena	Feb. 23, 1900	1152	1165	+ 13	
*Hypatia	do	703	705	+ 2	
Ida	Jan 1, 1901	810	765	— 45	
Hypatia	do	740	700	— 40	
Ida	Feb. 5, 1901	790	795	....	+ 5
Hypatia	do	730	755	....	+ 25
Annie	Jan. 1. 1901	795	767	....	— 28
Ada	do	830	840	....	+ 10
Susan	do	610	610	....	0
Annie	Feb. 5, 1901	745	697	— 48	
Ada	Feb. 5. 1901	845	780	— 65	
Susan	Feb. 5, 1901	610	585	— 25	
Total net gain				—202	+ 118
Average per cow, per period of 28 days				22.4	13.3
Average per cow, per day				— .8	+ .5

* Hypatia substituted for Annie in 2d period.

The gains in live weight during the first two feeding periods are not of particular interest so far as the rations are concerned, but they seem to depend upon the individuality of the cows. Ada gained 16 lbs. on the farm-grown ration and practically held her own on the "oil mill ration" losing only 1 pound. Queen lost

10 pounds on the farm-grown ration and gained 69 lbs. on the "oil mill ration." With the other two cows there was a slight gain in both periods.

On an average the cows on cotton seed lost in weight .8 of a pound per day, while those on the meal and hulls ration, consuming more food, gained .5 of a pound daily. The rations fed during the second experiment were decidedly laxative and the cows showed it in the milk yield and in the loss of live weight. In 1900 the raw cotton seed fed constituted 37.7 per cent of the "home-grown ration," while in 1901 it constituted 45.50 per cent of the "home-grown ration."

In 1900 the cotton seed meal fed formed 24.8 per cent of the "oil mill ration" and in 1901 it formed 27.7 per cent.

The table of live weight shows that in the second experiment all the cows lost in weight when on the farm-grown ration, while only one fell off on the "oil mill ration." The effect of cotton seed and cotton seed meal varied with the different animals, the greatest scouring being with cotton seed. In the first experiment Rozena, a very large cow, consumed an average of 8.9 pounds of cotton seed meal daily and appeared well in every way, while in the second period she consumed 9.6 pounds of cotton seed and did not show the effects for three weeks, when she scoured very heavily and fell off in milk flow. This was undoubtedly due to the large amount of oil in the cotton seed. In the second experiment Susan, a small heifer, took 6 pounds of cotton seed per day for the first period and appeared at her best during the whole of the month, but six days after being on cotton seed meal in the second period, getting 6.7 pounds per day, she commenced to scour and fell off in milk flow. This could not be due to a larger amount of oil in the ration, but

probably to the influence of the previous month's feeding of cotton seed, modified by the individuality of the cow. A cow that scours, even though it be slight, can not do her best at the pail.

In feeding cotton seed and cotton seed meal, as well as other feed stuffs, one must not rely on tables entirely, but be guided largely by the individuality of the animal with which he is dealing. The amounts of cotton seed meal used in the above experiments are larger than the writers would advise.

THE AMOUNT AND QUALITY OF MANURE COLLECTED FROM COWS ON DIFFERENT RATIONS.

First experiment, 1900. The manure, both liquid and solid, was saved every day, except that dropped when the cows were out of the barn and in bare lots where they spent the time between 8 a. m. and 4 p. m. Hence the manure actually saved consisted only of that dropped during 16 hours of each day, or of that voided during two-thirds of the time.

The liquid manure was saved by the use of sawdust as bedding material. The manure was removed every day to a shed, the roof of which consisted of 12-inch boards without battens, and hence having small cracks every twelve inches. This leak kept the manure moist but seems not to have resulted in any appreciable amount of leaching.

The manuure (including sawdust) collected during the time that the cows stood in the barn was as follows:

	Lbs. in 28 days, 2 cows.	Lbs. daily per cow.
From cotton seed and hay ration, 1st 28 days........	1785	
From do 2nd 28 "	1700	
Total and average..................	3485	31.04
From cotton seed meal and hulls ration, 1st 28 days.	2115	
From do 2nd 28 "	2430	
Total average	4545	40.6

These several lots of manure were applied to various farm crops; to ascertain the real or agricultural value of the two kinds of manures we must wait until the crop returns for several years can be reported.

No analyses of the manure was made in the experiment conducted in 1900.

The bedding used was fresh yellow fine sawdust, which in the first experiment was dry enough, but that used in the experiment of 1901 was too moist to be entirely satisfactory. The amounts of sawdust used per period (and included in the figures given above for manure) were with the cotton seed ration 391 and 639 pounds in the respective periods; with the cotton seed meal ration 520 and 644 pounds, respectively.

Second experiment, 1901. The same method as in 1900 was employed in collecting and handling the manure dropped during the 16hours per day that the cows spent in the barn. Only during the second period of this experiment was the manure kept separate and weighed.

The weights given are those obtained by weighing the bulk of manure and soiled bedding at the conclusion of the experiment.

The data follows:

	Lbs. manure from 2 cows, 28 days.	Lbs. manure daily per cow.
From cotton seed and hay ration....	1900	35.7
From cotton s. meal and hulls ration.	3138	56.0

These two lots of manure, each collected during parts of 28 days, were applied to farm crops, and the effects of these two classes of cow manure as compared with each other, with commercial fertilizers, and with no fertilizer, will be recorded in future bulletins of this Station.

The two lots of fertilizers collected as above during the last 28 days of the experiment, were carefully sampled at the end of the experiment and promptly analyzed; and the following table gives the results calculated by us from the analyses made by the chemical department of the Station:

Nitrogen, phosphoric acid, and potash in cow manure, 1901.

	From cow manure.	
	Cotton seed and hay ration.	C.S meal and hulls ration.
*Composition.**		
Nitrogen, ...per cent................	0 535	0.830
Phosphoric acid, per cent................	.340	0 350
Potash, ...per cent	.500	0.485
Moisture, ..per cent...............	64.00	66 140
Pounds in 1 ton of manure.		
Nitrogen, ...lbs	10 7	16 6
Phosphoric acid,......... lbs	6.8	7 0
Potash, ... lbs	10.0	9 7

The matter that is most worthy of note in the table above is the fact that manure made from a diet consisting largely of cotton seed meal and hulls is 55 per cent. richer in nitrogen than that made from the cotton seed and hay ration; a ton of the former contains 16.6 pounds of nitrogen as compared with 10.7 pounds of nitrogen in the manure from the latter or farm ration. As regards phosphoric acid and potash the two manures are on a practical equality.

* In 1901 the manure dropped during the day when the cows were confined for the *entire 24 hours* was also analyzed, the comparison being almost exactly the same as that of the manure saved during the second period of 28 days (see table above). There was in this fresh manure made from cotton seed, etc., 68 8 per cent. moisture; 0 515 per cent. nitrogen; 0 30 per cent. phosphoric acid; 0 39 per cent. potash. In the manure made from cotton seed meal the percentages were respectively, 68 37; 0.78; 0 325; 0.40. The only notable difference is in the nitrogen, of which the manure from the oil mills ration contained 51 per cent. more than was found in the cotton seed ration.

Proportion of total excrement dropped in barn.

In order to determine what proportion of the manure was dropped in the barn and what percentage in the lots during the eight hours that the cows daily passed in the latter, two cows getting the farm ration and two receiving the purchased foods were kept in the barn for 24 and 48 hours after the close of the experiment, the rations meantime being continued without change.

Solid & liquid excrement per cow in 24 hours.

Cotton seed ration.				Cotton seed meal ration.			
Cows.	Date.	Total excrement and sawdust.	Solid and liquid excrement.	Cows.	Date.	Total excrement and sawdust.	Solid and liquid excrement.
		Lbs	*Lbs.*			*Lbs.*	*Lbs.*
Ada and Queen	Feb. 13 & 14, 1900	55 8	47.8	Ada and Queen	Mar. 23&24, 1900	87 2	72.6
Rozena & Hypatia.	Mar. 23&24, 1900	73 1	56.8	Rozena & Annie.	Feb. 13& 14, 1900	61.5	46.1
Ada and Susan.	Mar 6, 1901 ...	53.8	..	Queen & Hypatia.	Mar. 6, 1901....	108 8	
Average ..	per cow	60.9	...	Average ...	per cow	84.2	
Average ...	per 1000 lbs live weight.	72 5	.	Average. ..	per 1000 lbs. live weight.	89 8	

The average amount of solid and liquid droppings and bedding per cow was 60.9 pounds per day with the ration containing cotton seed and 84.2 pounds per day with the ration containing cotton seed meal.

In 1900, with the cotton seed ration, the average amount of solid and liquid excrement dropped per cow in 24 hours (excluding bedding) was 52.3 pounds; the average daily amount of excrement (free from sawdust) collected during the 16-hour stabling period of each day was only 21.9 pounds.

In 1900, with the cotton seed meal ration, the average amount of excrement, free from sawdust, dropped per cow in 24 hours was 59.4 pounds; the average amount collected during the 16 hours of stabling was only 30.2 pounds.

Apparently about one-half the manure was dropped in the barn and about one-half in the lots.

This statement is important because the manure dropped on the lots or pastures usually suffers greater losses, and hence is worth less than that collected while the cows are in the stable. However, the high value of manure from grain fed cows should prompt every dairyman to gather and protect the manure from the lot as well as that from the barn.

In conclusion let us note that the manure from the cotton seed meal ration was greater in amount and much richer in nitrogen than that from the cotton seed ration. Taking the average amounts of manure in all cases where the cows were confined for the whole day and using the analysis of the samples collected in the last periof of 28 days in 1901, we find that the daily excretion of liquid and solid excrement (including bedding) contained plant food as follows:

	Lbs. nitrogen.
60.9 lbs. manure from cotton seed ration..........	.306
84.2 lbs. manure from cotton seed meal ration....	.700

With the cotton seed meal ration the daily output of nitrogen in the manure was more than twice as great, and the amounts of phosphoric acid and potash considerably larger than with the ration made up largely of cotton seed.

GREEN RYE SUBSTITUTED FOR COTTON SEED HULLS AND FOR SORGHUM HAY.

For 3 weeks beginning March 22, 1900, the four cows which had been used in the experiment comparing a farm-grown with a purchased ration, were fed on green rye as a substitute for the cotton seed hulls and for the sorghum which they had been eating during the second period. The grain ration of the second period was continued in same proportions but in greatly reduced amounts. The rye was in full bloom and rather too old. Excluding the first, or preliminary, week, we find that the result for period III, consisting of 14 days, were as stated below:

Food consumed and milk and butter afforded by 2 cows in 14 days from different rations.

	Lbs. food in 14 days.				Gain or loss in weight	Cotton seed ration.		Cotton seed meal ration.	
	Green rye.	Cotton seed.	Cotton seed meal	Bran and corn mixture. 1:1.		Milk.	Butter.	Milk.	Butter.
					Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Ada......	773	...	50 0	36 0	+ 8	.....	....	298.9	12 78
Queen.....	689	....	73.4	83 9	— 32	......	. .	424.0	13.88
Rozena..	783	88 8	......	59 8	— 7	364 8	13 15	......	.....
Hypatia...	731	52 8	.....	35.2	— 14	272 9	15 27	......	......
Total, 2 cows	.....	...	.....	......	....	**687 7**	**28 42**	**722.9**	**26 66**

Counting green rye at $2.00 per ton and other food-stuffs at prices before mentioned, we find that the cost of food to make one pound of butter was 15.4 cents when cotton seed meal was fed and only 10.5 cents when cotton seed was fed.

This difference in favor of cotton seed over cotton seed meal as an economical producer of butter is apparently too great to be attributed to individual peculiarities of the cows of the two lots, which were chosen with reference to their practical equality.

Direct comparison of green rye as a substitute for either cotton seed hulls or sorghum hay can not be made in this experiment. However the substitution of rye for cotton seed hulls, and also for sorghum hay, reduced the cost of butter, partly perhaps because the large amount of green rye eaten made it practicable to reduce the amount of concentrated food.

Comparing the average daily product during period III with that of the last two weeks of period II, and making no allowances for the fact that the cows while on rye were further removed from time to time of calving than when receiving sorghum or cotton seed hulls, we find:

(1) That the substitution of 52 lbs. of green rye for 14.9 lbs. of hulls (grain also being reduced when rye was fed thus changing the nutritive ratio from 1:4 to 1:3.7), was accompanied by a shrinkage of 19 per cent. in butter and 9 per cent in milk.

(2) That the substitution of 54 lbs. of green rye for 9.1 pounds of sorghum hay (grain also being reduced when rye was fed, changing the nutritive ratio from 1:6.5 to 1:7.3) increased the yield of milk by 18 per cent. and the yield of butter to the extent of 6 per cent.

The results of feeding rye were highly satisfactory

for they show that rye was practically able to maintain the normal product (actual yield corrected for advance in location) of butter and to slightly increase that of milk and that its use allowed the daily ration of concentrated food to be decreased to the extent of more than 5 pounds per day, without materially impairing the amount of product. These facts and figures point to an increased use of green crops in late winter and early spring as an effective means of reducing the bill for purchased foodstuffs. An uninterrupted succession of crops for feeding green (soiling) may be had by the use of rye, wheat, common oats, hairy vetch (mixed with small grains), turf oats, and sorghum, etc.

Since the health and working capacity of cows are so greatly improved by soiling crops they should find increased favor.

EFFECT OF GREEN FOOD ON RICHNESS OF MILK.

It is a common belief that milk made from green food contains more water and less fat than that from dry foods. The results of the few experiments made on this point do not bear out the popular belief.

Our results on this point were obtained by making a composite test for butter fat, once a week.

It should be recollected that these determinations of fat were not begun until after the cows had been eating rye for a week. For comparison, we give the percentages of fat found in the milk of the same cows for the weeks beginning March 9 and March 16, 1900, at which time they were receiving only dry food, and a heavier grain ration (though similar in kind) than was given with the rye.

Per cent. of fat in milk; results of composite weekly tests.

NAME.	On dry food, and heavy "grain" ration.		With green rye, and moderate "grain" ration.		
	Date.	Per cent. fat.	Date.	Per cent. fat.	Loss on green food.
					%
Ada........	Mar. 9–15... / Mar. 16–22..	3 7 / 4 0 } 3.85	Mar. 30-A. 5. / Apr. 6–12...	3.5 / 3.8 } 3.65	.20
Queen......	Mar. 9–15.. / Mar. 16–22	3.2 / 3.4 } 3.30	Mar 30-A. 5. / Apr. 6–12...	3. / 2.8 } 2.90	.40
Rozena.....	Mar 9–15 .. / Mar. 16–22..	4.1 / 4.2 } 4.15	Mar. 30-A. 5 / Apr. 6–12...	3.0 / 3.2 } 3.10	1.05
Hypatia....	Mar. 9–15... / Mar. 16–22..	5.0 / 4.6 } 4.80	Mar. 30-A. 5 / Apr. 6–12...	4.8 / 4 8 } 4.80	.00
Average decrease in % fat	....	....	....	....	.41

The uniformity of the figures indicate a decrease in per cent. of fat in the period when rye was fed. It cannot now be said whether it was due to the green food, to temperature conditions, or to a large reduction in the grain ration. The effect of green foods as fed in the South on the percentage of fat in the milk requires further study.

DIGESTIBLE NUTRIENTS IN THE SEVERAL RATIONS FED.

The following table given the amount of digestible nutrients consumed per day in the different periods in comparison with the German or Wolff-Lehmann Standard, which represents the daily requirements of an average cow in full flow of milk:

Digestible nutrients in rations fed.

Ration.	Average weight of cows.	Dry matter.	Digestible nutrients. Protein.	Carbohydrates.	Ether extract.	Milk per day.	Nutritine ratio.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Wolff-Lehmann Standard.	1000	29	2.5	13	.5	22	1:5.7
"Farm-grown," 1900..	915	18 75	1 85	9.21	1 81	20.7	1:7.3
"Oil mill," 1900.......	957	28.19	3.82	11 98	1.01	29 6	1:3.7
"Farm-grown," 1901.	772	13.07	1.37	5.76	1.42	14.3	1:6.6
"Oil mill," 1901.......	752	25 46	3.64	8.86	1.38	19.0	1:3.2
Rye & cotton s., 1900..	970	20 9	2 2	11.2	1 81	22.7	1:6.5
Rye & c. s. meal, 1900.	960	20.6	3.21	10 71	.90	25.8	1:4.0

Speaking in general terms, protein is that part of the food that goes to make milk, muscle, bone, etc., while carbohydrates (starch, sugar, etc.) and ether extract (fat, etc.) are used as fuel and to give force. Protein is nitrogenous material, and carbohydrates and ether extract are non-nitrogenous. Both classes of compounds must be present in the food to keep the body in its normal working condition.

The average daily ration per cow was as follows:

Cotton seed ration—
- 5.6 lbs. cotton seed.
- 3 7 lbs bran and corn mixture.
- 54 lbs. green rye.

Cotton seed meal ration—
- 4.4 lbs. cotton seed meal.
- 5.0 lbs. bran and corn mixture
- 52 lbs. green rye.

It should be noticed that the cowing eating the cotton seed ration could never be brought up to full feed, or the amount necessary to produce a full flow of milk; in one experiment their ration dropped nearly down to half

what the Germans have found to be desirable for a cow to eat.

On the other hand the cows getting cotton seed meal in all cases consumed more protein than necessary.

The nutritive ratio is the number of times that the ratio of the amount of protein (taken as 1) to the total amounts of carbohydrates and fats, the fats having first been multiplied by 2¼. The nutritive ratio was narrow (represented by a small number) when cotton seed meal was fed, and wider (or less rich in nitrogen or protein) when cotton seed was fed.

VALUE OF COWPEAS IN CORN FIELDS AS PASTURAGE.

For a period of 19 days, October 7 to 25 inclusive, 1900, three Jersey cows were grazed in a corn field from which the ears had been pulled, the grazing consisting principally of cowpeas, of what remained of the corn blades, and of a little crab and crowfoot grasses.

The corn was planted March 28 in rows five feet apart. Half way between the corn rows was a row of drilled Wonderful cowpeas planted June 4, without fertilizer. The yield of corn was about 25 bushels per acre.

While the cows were grazing in the corn field on cowpeas each received a daily allowance of 3 pounds of cotton seed meal.

From September 23 to October 6 each cow also consumed 3 pounds of cotton seed meal per day. During this earlier period of three weeks, they grazed in a large pasture of bermuda, lespedeza, (Japan clover, carpet grass, etc.) so that the yields made on pea vines can be properly compared with those made on ordinary pasturage. The following table shows the amount of milk and butter afforded daily by each cow:

Average amount of milk and butter produced daily.

Cow.	Milk from		Butter from	
	Mixed pastur'ge.	Cowpeas, etc.	Mixed pastur'ge.	Cowpeas, etc.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
Ida	23.94	25.53	1.03	1.13
Houron	9.72	15.5	.81	.97
Susan	17 64	18.37	1.00	1.01
Average per cow. daily	17.1	19.8	.95	1.04
Per cent. increase	......	15 8	......	9.5

Comparing the product obtained when the cows grazed on cowpeas with that made from ordinary pasturage, we find that the cowpeas gave an average increase of 15.8 per cent in milk and 9.5 per cent in butter. It should be noted that this increase occurred in spite of the fact that the cows were further advanced in the period of lactation when grazing on cowpeas than when on ordinary pasture.

The total amount of product obtained from the three cows during the 19 days while they grazed on cowpeas in a corn field of 3.03 acres was 1129.5 pounds of milk and 59.17 pounds of butter. During this time the three cows consumed a total of 171 pounds of cotton seed meal.

The three cows Ida, Susan, and Houron, during the 19 days while pasturing on cowpeas made gains in live weight of 2687 pounds, subsisted for a period of 85 pounds for the lot. When the field was grazed so close as to threaten to reduce the milk flow, these three cows were removed and three dry Jersey cows were substituted. These three dry cows, with a total initial weight of 2687 pounds, substituted for a period of 9 days on what remained of the grazing on 3.03 acres, meantime receiving no other food whatever and making gains of 12, 16, and 25 pounds, a total of 53 pounds for the lot. Adding this to the 85 pounds gained by the cows giving milk, we have a total gain in live weight of 138 pounds.

The returns from grazing 3.03 acres of cowpeas are brought out by the following:

Financial statement.

By 59 17 lbs. butter. @ 20c		$11.80
By 188 lbs. increase in live weight, @ 2½c		3.45
To 171 cotton seed meal. @ $20	$ 1.71	
Balance (value of 3.03 acres pasturage)	13 54	
Total	$ 15.25	$15 25

Since $13.54 represents the returns from 3.03 acres, the value of the grazing on one acre is $4.47.

The peas were planted for their fertilizing value and the butter removed practically none of this. Hence the cost of growing the peas should be charged in the fertilizer bill of the following crop, and not to the butter produced. However, if it be insisted that this is a proper charge against the cows the expense consists only of the cost of seed, labor of dropping and of covering, the total being somewhat less than a dollar per acre.

If we charge all of this expense of growing the peas to the cows giving milk and entirely neglect the gains made in live weight (the value of which was greater than the cost of growing the peas) the cost of concentrated feed and of pasturage was 8 cents per pound of butter. Balancing gains in live weight against cost of making the pea crop, we have 2.9 cents as the cost of purchased food per pound of butter.

Since there are more farmers interested in beef production than in commercial dairying, we have made an estimate as to the amount of growth of beef cattle that might be expected on an acre, using Thorne's figures as to the relative amounts of food required to make a pound of butter and of beef. By this method we estimate that an acre of grazing of this character made without the aid of any other food, animal products equal to about 80 pounds of increase in live weight. This is confessedly only an estimate but it is in accord with the small amount of data from other sources which is available on this subject.

BULLETIN No. 115. AUGUST, 1901.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

COMMERCIAL FERTILIZERS

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Acting Chemist.

A. ROEMER,
PRINTER FOR STATE OF ALABAMA,
MONTGOMERY, ALA.
1901.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

*To be filled.

AUBURN, ALA., July 24, 1901.

HON. R. R. POOLE,

Commissioner of Agriculture,

Montgomery, Alabama.

DEAR SIR:

I have the honor to submit herewith, in tabulated form, a report of the results of analyses of commercial fertilizers and miscellaneous fertilizing materials for the year ending July 1st.

A large majority of these samples were forwarded to this laboratory through your office, and certificates of analysis were furnished you from time to time as the work was finished. A large number, however, were sent direct to us from dealers and consumers, and in all these cases certificates of analysis were sent direct to the parties.

In addition to the analysis reported in this bulletin, analyses, both quantitative and regulative, of various miscellaneous substances—ores, marls, minerals, waters, dairy products, &c.—have been made for parties from all sections of the State, and have been reported from time to time.

As an introduction to the tables, I respectfully submit a few observations on "Fertilizers—their selection and use," which, it is hoped, will prove of some practical value to the farmers who receive this bulletin.

Very respectfully,

JAS. T. ANDERSON,

Acting State Chemist.

Fertilizers--Their Selection and Use.

Few farmers need be reminded of the necessity of applying fertilizers in some form to their soils in order to maintain their fertility and to increase their crop producing power. The question is not "Shall I fertilize?" but rather "What fertilizers shall I use?" It is proposed in this brief discussion to offer a few suggestions which it is hoped, will be of some value in this connection. These must be taken as suggestions merely, and not as absolute guides in solving the problem. In the present state of knowledge of the science of agriculture, it is impossible to state any general principle of soil fertilization which will be of universal application, so complex are the conditions and requirements to be considered. The character of the soil and the method of its cultivation, the crop to be grown, the season—all these are to be considered in devising any rational system of fertilization.

A soil is fertile when it contains all the materials nec-

essary for plant growth in the required quantity and in the proper form. A soil which is lacking in any of these materials, or which does not have them in the proper form, is in no condition to produce a full crop, and must have the deficient material supplied in the proper amount and form in order to make it productive. As has frequently been stated in these bulletins, there are about a dozen constituents of the soil that are required for plant nutrition. Most of these are found in such quantity in the soil, or are in such little demand by the plant, that the supply of them in the soil is not likely to be exhausted by years of cultivation. Three of the constituents, however, nitrogen, phosphoric acid and potash, are in such demand by the plant that their supply is readily exhausted, and it is necessary to restore these exhausted constituents to the soil in order to make it fertile. For the present, then, soil fertilization consists in restoring to the soil nitrogen, phosphoric acid and potash in such quantities in assimilable form as may be required for the proper nutrition of the growing crop. The rational course, therefore, to pursue with reference to a given soil is first to determine its deficiency in these three constituents and then to supply the deficiency in proper form.

It is not an infrequent occurrence for this department to receive a sample of soil with the request to tell what it needs for its proper fertilization. The correspondent is acting on the hypothesis that a chemical analysis of a soil will determine its fertilizer requirements. Unfortunately it will not do so satisfactorily. The chemist can easily determine what constituents are present in the soil and in what quantities, but he cannot so readily determine whether these constituents are present in assimilable form, and if they are not present in assimilable form, they might as well be absent altogether, as far as

the present needs of the growing plant are concerned. Many agricultural chemists, in this and other countrios, are seeking to discover methods for determining available or assimilable plant food in soils, but at present there is no such method known which is satisfactory and which admits of universal application.

If chemical analysis fails to answer the question, it may be asked, is there not some way by which the solution may be found? In answer let us quote the language of Dr. Armsby of the Pennsylvania station: "The most satisfactory, and, indeed, usually the only method by which we can at present determine the needs of the soil is to ask the question of the soil itself by growing a crop upon it with different kinds of fertilizers and noting the results. Such soil tests with fertilizers have in many cases given results of much immediate practical value for the locality in which they where undertaken."

On this plan have been conducted for several years the Cooparative fertilizer tests for cotton under the direction of Professor Duggar of the Agricultural Experiment Station of this State, and much valuable information has been accumulated thereby. It would be highly advantageous to the agricultural interests of the State if this work could be greatly extended beyond its present limits. It seems to the writer quite feasible for each intelligent farmer to conduct the experiments for himself and thus secure data that would be highly useful to him. At first glance they may seem complicated and expensive, but in reality they are neither so difficult nor so expensive as they seem. For the benefit of any farmers who may desire to make them the following suggestions are offered:

Select ground that represents fairly as large an area of the farm, and whose soil is as uniform in character as

possible. A long strip of land is likely to be more representative in character than a square piece, as it will contain more of the inequalities of the soil, and for this reason is to be preferred for the purpose of these experiments. The land should be as level as possible, and if not level, the plots should be so located that the fertilizers cannot be carried by rain from one plot to another. No part of the strip should be shaded by trees. A convenient size would be 33 feet wide by 416 feet long divided into 6 equal plots each 66 feet long, with a path 4 feet wide between the plots. Each plot, therefore, would be 33x66 feet and measuring exactly one-twentieth of an acre. Each plot should be separated from its neighbor plots, as well as from adjacent cultivated ground, by a 4 ft. path, so that the roots of the plants grown on it can get no fertilizer that is not intended for them. Of course these paths or borders should be kept reasonably free from grass and weeds, which would otherwise feed upon the fertilizers intended for the plants in the plots. Having divided up the plots as indicated and marked them by numbers from 1 to 6 inclusive, prepare the soil thoroughly in the usual way, after applying the fertilizers broadcast as follows:

Plot 1.	No fertilizer.		
Plot 2.	Nitrate of soda	20	lbs.
	Acid phosphate	60	"
Plot 3.	Nitrate of soda	20	"
	Muriate of potash	16	"
Plot 4.	Acid phosphate	60	"
	Muriate of potash	16	"
Plot 5.	Nitrate of soda	20	"
	Acid phosphate	60	"

Muriate of potash.............16 lbs.

Plot 6. No fertilizer.

The acid phosphate in these experiments should contain not less than 8 to 10% of available phosphoric acid. If cotton is to be used in the experiment, use kainit in the place of muriate potash, taking 48 lbs. If legumes, such as clover, peas, beans or vetch, are to be used, cut the amount of nitrate of soda one-half. It is recommended that that crop be used in the experiments which is to be grown in the field the following season, in order that the results of the experiment may be directly applicable. In planting care should be taken to have the plants uniformly distributed over the plots, and as nearly as possible the same number of plants in each plot. The plots should be treated alike in all respects as to the time and manner of cultivation, and in passing from one plot to another, extreme care should be taken not to mingle the soil from one with that of another. This last caution is particularly applicable, when the plow is used in the cultivation. The harvest from each plot should be accurately weighed and the weights recorded. The importance of keeping a full and accurate record for each plot—the kind and amount of fertilizer used, the system of cultivation, and the harvest yield—cannot be too strongly urged. It will be observed that plots 1 and 6 have no fertilizer. These are check plots and are designed to show what the unfertilized soil can do. They will be especially useful in comparatively new soil or in soil that has been previously fertilized, but they should in no case be omitted.

If these experiments have been properly conducted, reasonable inferences may be drawn from a study of the results as to the fertilizer needs of the soil. Too much importance cannot be attached to the conscien-

tious carrying out of every detail. The experiments should be under the personal direction of the farmer himself, and where any part of the labor must be done by another, the most intelligent and reliable laborer should be selected for that purpose.

It is realized that but few farmers are likely to be induced to undertake these experiments, and in the absence of other means of determining the specific needs of the soil, most farmers must assume that all the constituents are needed and must supply them in such amount and in such form as the general considerations of the soil, season and crop may seem to require. So varied are these conditions that it would be impossible to give specific instructions as to methods of fertilization. A few general principles, however, as to the needs of special crops may be stated, which, it is hoped, will serve a useful purpose.

Cotton is a crop that responds promptly and profitably to judicious fertilization, and experience teaches that concentrated complete fertilizers should be used. The profit from manuring with concentrated fertilizers is greatly enhanced by properly preparing the soil in advance. It is profitable to bring the soil into a state of good "tilth" by proper cultivation, and particularly by incorporating into it liberal quantities of organic matter. This may be done by turning under leguminous crops (like the cowpea) or barnyard manure before planting. The complete fertilizer, applied in the drill, should contain a liberal amount of "available phosphoric acid." Any of the soluble salts of potash are good, though kainit is preferred, as it is believed to be useful in preventing "blight." Of nitrogen compounds the organic forms (cotton seed meal, dried blood, tankage, &c.,) are deemed to be best suited for cotton, though nitrate of soda

is excellent, especially in soils rich in organic matter. The proper proportions of available phosphoric acid, potash and nitrogen in a complete fertilizer for cotton cannot be said to have been determined with accuracy. As a result of numerous experiments at several of the agricultural experiment stations, 600 to 700 lbs. per acre of a fertilizer running 9% available phosphoric acid, 3% potash and 3% nitrogen is to be recommended.

For cereals and grasses nitrogen has been considered the dominant constituent. This arises from the fact that a top dressing of nitrate of soda at the season when there is a rapid development of stem and leaf, results in a largely increased crop. This occurs, however, only in soils which have a plentiful supply of the mineral constituents, phosphoric acid and potash. It is recommended, therefore, to use at the time of sowing a fertilizer containing a liberal amount of phosphoric acid and potash with a limited supply of nitrogen, and shortly before the maturity of the plant top dress with nitrate of soda.

The Legumes (clovers, peas, beans, vetches, &c.) are crops that do not depend solely on the soil for their nitrogen, but which, under favorable conditions, have the power of drawing at least a part of their nitrogen supply from the atmosphere. To this fact is due their superior excellence as soil renovators, since their growth upon a soil must result in its enrichment in the most costly of the fertilizer constituents, nitrogen. In fertilizing legumes, then, provide a liberal supply of the mineral constituents and a minimum of nitrogen. They seem to require potash in great abundance, Lime, also, is needed to correct a tendency to acidity in the soil which is hurtful to the growth of the bacteria so essential in order that the plant may acquire its nitrogen from

the atmosphere. 25 bushels of stone lime per acre, every 4 or 5 years, is recommended for average soils which are used for the frequent growth of legumes.

Root and Tuber Crops require an abundance of all the fertilizing constituents in readily available forms, but they differ widely as to their special needs. In one group may be placed *beets, carrots and mangels*. They require a liberal supply of readily soluble phosphoric acid and nitrogen, and in light, sandy soils the addition of a little potash is advisable. In clay soils they seem to be able to get most of the potash they require from the soil. *Turnips* respond most liberally to applications of available phosphoric acid, while they seem able to extract this constituent from sources not readily accessible to other plants. A liberal supply of nitrogen, also, especially during early growth, is desirable. While the turnip is a voracious feeder on potash compounds, it seems able to obtain this constituent from the natural soil supply, though it should not be required to depend solely on this supply. *Potatoes*, both irish and sweet, require a large amount of potash, which should be in the form of sulphate rather than of muriate. The nitrogen may be mostly in organic forms, though the nitrate of soda or sulphate of ammonia is recommended for the early irish potato. The phosphoric acid in moderate amount should be available.

Fruit Crops differ from the others that we have considered in that they are produced by perennial plants instead of by annuals, and hence they require a different sort of fertilization. As the plants grow slowly, fertilizing materials which give up their constituents slowly are better, perhaps, than those whose constituents are more readily available. Fertilizers of the latter class, however, may supplement those of the former with advantage at such times as there is a rapid devel

opment of leaf and fruit. Perhaps the best fertilizer for fruit trees is a mixture of ground bone 3 parts and muriate of potash two parts. An excess of nitrogen must be avoided, as this causes a too rapid growth of both wood and fruit, the latter ripening poorly under such conditions. All fertilizers for fruit crops should be worked well into the soil.

CALCULATION OF COMMERCIAL VALUES OF FERTILIZERS.

The schedule of valuations in force this season is as follows:

Nitrogen	14	cents	per	pound.
Water soluble phosphoric acid	5	"	"	"
Citrate soluble	5	"	"	"
Potash	5	"	"	"

To compute the commercial value of fertilizers according to this scale, the valuation per ton of water soluble and citrate soluble phosphoric acid and potash is obtained by multiplying the per cent of those constituents by $1 00, while the value of the nitrogen per ton is ascertained by multiplying the per cent. of that element by $2.80.

Take for example a fertilizer containing

7.50 per cent. of water soluble phosphoric acid.
2.00 " " " citrate soluble " "
1.25 " " " potash.
2.50 " " " nitrogen.

the commercial value per ton would be:

For the water soluble phosphoric acid	7.50x1.00–$7.50
" " citrate soluble " "	2.00x1.00 $2.00
" " potash	2.00x1.00–$2.00
" " nitrogen	2.50x2.80–$7.00
Total	$17.75

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6200	Alabama Phosphate (So called).....	N. M. Rhodes M. & M. Co.. Shell, Ala..	5.90	5.13	2.42	1.56	1.15	$16.55
6201	Alabama Fertilizer.............	" " " " " "	6.90	2.35	1.80	1.96	2.76	17.50
6208	Dale County Standard Guano......	Ozark C. S. O. M. & F. Co., Ozark, Ala.	8.75	3.17	1.08	1.64	3.25	19.76
6209	Ozark H. G. Guano..........	" " " " " " "	9.65	2.53	1.20	1.22	2.95	18.55
6210	Guano No. 3......................	" " " " " " "	9.70	2.39	1.26	1.24	2.52	18.08
6224	B'ham Dis. Bone Am. and Potash...	Birmingham Fert. Co., Birmingham, Ala.	10.00	3.38	.37	.99	1.05	17.20
6225	B'ham H. G. Blood, Bone & Potash.	" " " " "	10.23	3.35	.37	1.87	2.22	21.04
6229	Dale Co. Standard Guano..........	Ozark C. S. O M. & F. Co., Ozark, Ala..	6.35	4.48	.50	2.36	4.11	21.55
6230	No. 2 Ozark Guano.	" " " " " " "	7.45	6.78	.91	1.32	7.84	22.77
6231	Hemes Special Guano No. 1........	Helm Bone Fert. Co., Birmingham, Ala.	0.00	5.49	6.16	1.80	2.29	12.82

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6232	Helm's Special Guano No. 2........	Helm Bone Fert. Co., Birmingham, Ala.	0 00	4.61	5.44	1.65	2.00	$11.23
6238	Farmers' Alliance Guano.	Troy Fertilizer Co., Troy, Ala.........	7.15	3.25	2.65	2 02	2.32	18.38
6239	Big Hit Guano.............	" " " " "	6.50	3 38	3 32	1 38	1.53	15.27
6240	Blood and Bone Guano...........	" " " " "	8.05	3.23	2.42	1.64	2.28	18 17
6241	Hume's Am. Dis. Bone	" " " " "	8.25	2.41	2.52	1.60	2.32	17.46
6242	Meal Mixture................... ..	" " " " "	7.05	2.73	2.22	1.84	2.18	17.11
6243	Nancy Hanks......................	" " " " "	7.40	2.84	2.36	2.02	2.57	18.47
6244	Old Homestead..	" " " " "	6.55	3.16	3.74	1.16	1.58	14.49
6245	Pike's Pride Guano.	" " " " "	8.00	3 25	2.40	1.66	2.00	17.90
6246	Troy Perfect Guano...............	" " " " "	6.95	2.91	2.04	1.96	2 82	17.67

6247	Soluble Blood and Bone	Troy Fertilizer Co., Troy. Ala	7.10	2.48	3.52	1.26	1.66	14.77
6248	Blood and Bone Guano	" " " " "	8.25	2.85	2.20	1.60	2.00	17.58
6249	Dundee Guano	" " " " "	6.75	2.86	3.34	1.18	1.68	14.59
6254	Fertilizer	Cliff Foy & Bros., Abbeville, Ala	8.55	2.95	.90	2.08	1.66	18.98
6257	Jones Special Formula	Hilton, Bentley & Cosby, Brantley, Ala.	7.85	2.45	3.09	1.10	3.70	16.58
6259	Gray's H. G. Guano	—— Gray, Dadeville, Ala	9.50	2.16	.44	1.50	2.34	18.20
6269	Birmingham Dis. Bone and Potash	B'ham. Fért. Co., Birmingham, Ala	9.90	3.78	.42	.99	1.84	17.79
6270	B'ham H. G. Blood, Bone & Potash	" " " " "	10.85	3.63	.32	1.84	2.52	21.65
6271	Birmingham Soluble Guano	" " " " "	9.80	4.48	.42	1.90	1.31	20.91
6272	Birmingham Standard Grade Fert.	" " " " "	9.75	4.25	.40	1.80	1.18	20.22
6275	Guano	G. W. McKing, Five Points, Ala	5.75	1.68	3.22	1.74	1.97	14.27
6278	Guano	W. L. Patterson, Oswichee, Ala	8.45	2.50	.70	1.98	1.57	18.06
6279	Fertilizer	W. L. Cosby, Walnut Hill, Ala	7.80	2.42	.28	1.40	2.72	16.86
6282	Patapsco Guano	O. J. Belcher, Headland, Ala	8.75	2.93	1.82	.94	1.00	15.31
6291	Grays H. G. Guano	Dadeville Oil Mill, Dadeville, Ala	7.70	2.78	.22	1.56	1.79	16.64
6292	Stone & Johnston's H. G. Guano	" " " " "	7.90	2.79	.26	1.58	1.92	17.03
6293	Home Mixture Guano	" " " " "	7.80	1.91	.44	1.50	2.20	16.11
6297	Guano	S. M. Day, Five Points, Ala	6.60	5.00	6.60	1.46	.75	16.44

Analyses Reported by the State Chemist from July 1. 1900, to July 1, 1901.

ACID PHOSPHATES WITH NITROGEN AND POTASH—Continued

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6298	Goldsmith's Improved Mixture.	Prim & Kimbel, Jackson, Ala.	8.60	3.12	2.68	2.00	2.73	20.05
6303	Aurora	Herren & Oliver, Dadeville, "	9.00	3.20	2.25	1.66	1.19	18.04
6304	A. A. P.	" " " "	9.30	4.13	2.32	1.00	1.45	17.68
6305	Coweta H. G. Guano	" " " "	9.20	2.35	2.60	1.80	2.29	18.86
6306	W. O. C	" " " "	8.45	3.48	3.32	1.80	2.35	19.32
6313	Blood, Bone and Potash	McGhee, Driver & Co., Lafayette, Ala.	5.65	5.21	4.14	1.60	1.24	16.58
6314	Mastodon	" " " " "	8.70	2.44	1.36	1.44	2.18	17.35
6317	H. G. Potash Guano	R. A. Russell & Co., Gaylesville, "	6.00	3.92	2.18	1.34	2.07	15.74
6318	Blood and Bone Guano	" " " " "	7.00	4.39	2.06	1.16	1.07	15.71
6325	Capital City Standard Guano	Wright, Henderson & Co., Elba, "	6.05	4.07	4.08	1.64	2.32	17.08

6326	Troy Perfect	Wright, Henderson & Co., Elba,	"	6.85	2.59	8.06	2.20	2.07	16 57
6327	Georgia State Grange Guano	" " " "	"	5.06	3.85	2.80	1.39	2.17	14 93
6331	Georgia State Standard	Sanders & Son, Columbia,	"	5.75	3.45	4.00	1.86	2.00	16 41
6334	B'ham H. G. Blood, Bone and Potash	Lester & Co., Columbiana,	"	8.50	4.06	1.94	1.34	1.58	17 84
6337	Blood and Bone	H. M. Beach & Son, Columbia,	"	5.60	4.02	2.08	1.61	1.87	16 20
6338	Comple Cotton Fertilizer	" " " "	"	8.65	1.71	2.24	1.80	2.88	17 78
6339	Jones' Formula	" " " "	"	8.65	3.52	1.98	1.04	3.48	18 76
6340	Excelsior	" " " "	"	8 00	2.10	1.30	1.65	1.69	16 39
6341	Farmer's Special	" " " "	"	6.70	5.74	1.46	1.11	4.82	20 37
6342	Helmet	" " " "	"	8 20	5.69	3.36	1.90	2.42	16 63
6345	Ox Cotton Guano	T. C. Masterson, Avoca,	"	8.70	4.39	1.26	1.70	1.55	19 40
6347	Armour's 271	C. A Steifelmeyer, Hanceville,	"	2.65	7.61	1 34	1.94	1.65	17 54
6348	Meridian Blood and Bone	" " "	"	8.55	3.38	1.92	1.74	1.59	18 39
6350	Early Bird	Reynolds Bros., Jemison,	"	8.10	3.75	6.20	1.24	1.64	16 96
6353	Georgia Formula Guano	Campbell & Wright, Jr., Roanoke,	"	8.85	2.40	2.60	1.72	2.24	18 31
6354	Georgia State Grange Guano	" " " "	"	7.90	2.19	.94	1.65	3.38	18 01
6355	Pon Pon Crop Grower	" " " "	"	8.50	2 04	2.56	1.22	2.94	16 90
6356	Randolph Guano	" " " "	"	5.50	2.58	1.92	2.54	2.29	17 48

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6257	Roanoke Guano..................	Campbell & Wright, Jr., Roanoke, Ala.	7.25	2.45	2.70	1.98	1.41	$16 65
6367	B'ham Food, Bone and Potash	S. E. Stewart, Hartselle, Ala	7.50	2.80	3.40	1.50	1.76	16 26
6338	Alabama Guano..................	" " " "	7.50	2.81	2.04	1.98	2.06	17 71
6369	Adair's Am. Dis. Bone	" " " "	7 00	1.64	2.86	1.88	2.88	16 28
6370	Ga. State Grange Fertilizer........	" " " "	8.10	1.73	3.02	1.54	2.85	16 99
6371	Ox Cotton Guano	" " " "	8.95	3.84	1.86	1 56	1.74	18 90
6373	Read's H. G. Am. Dis. Bone........	" " " "	8.40	3.97	1.48	.72	2.90	17 29
6374	Sample No. 1	C. R. Maxwell, Northport, "	8.75	.90	.40	1.22	2 86	15 87
6375	Sample No. 2	" " " "	10 00	1.44	.36	1.16	2.76	17 45
6377	Helmet Brand Potato Fertilizer...	S. F. Alston, Tuscaloosa, Ala	2.30	9.46	2.24	3.72	4.22	26 40

6378	Helmet Brand Blood, Bone & Pot'h	S. F. Alston, Tuscaloosa, Ala	2.25	9.18	1.62	4.18	10.40	38 58
6379	Helmet Brand 271	" " " "	1.85	8.11	1.14	2.14	1.74	17 69
6380	Helmet Brand 336	" " " "	3.30	8 64	2 06	2.50	7.55	28 49
6383	King Cotton Grower.	W. D. Hamilton, Guin, Ala	6 75	4.19	5.26	.60	1.29	18 91
6385	Scott's Gossypium Phospho	C A. Steifelmeyer, Cullman, Ala	9.90	1.71	1.21	1.88	3.28	20 18
6387	B'ham Blood, Bone and Potash	" " " "	8.40	3.81	1 64	1.45	2.18	18 40
6389	Bone Compound	" " " "	7.25	2.90	6.20	1.60	2.07	16.70
6390	Standard Home Mixture	" " " "	7.45	3 82	1.08	1.62	2.90	18 71
6391	Helmet Brand 271	" " " "	2.00	7.78	1.52	2.12	2.09	17 76
6394	Ga. State Standard Superphosphate.	Law & Davis, Lincoln. Ala	6.25	3.91	2.44	1.68	3.32	18 18
6395	Scott's Gossypium Phospho	" " " "	7.40	4.79	.96	1.86	3.20	20.60
6396	Scott's Blood Formula	" " " "	7.15	4 87	2.06	1.10	2.25	16 85
6399	W. O. C.	S. F. Teague, Birmingham, Ala	6.30	2.98	3.32	1.58	2.64	17 84
6400	Teague's Beef, Blood and Bone	" " " "	6.55	3.58	4.02	1.04	2.07	15 06
6402	Animal Ammoniated	T. H. & A. B. Stephens, Seaborn, Ala	7.05	2.87	2.68	1.74	1.68	16 47
6403	Blood Formula	" " " " "	9.45	3.13	2.12	1.08	1.86	17 46
6405	B'ham H. G. Fertilizer	F. Ogden & Son, Sulligent, Ala	8.35	3.98	.72	1.54	2.78	19 42
6406	Mobile Standard Guano	" " " "	5.50	3.97	6.08	1.82	3.42	18 15

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6408	Ox Cotton Guano	Porter & Foster, Town Creek, Ala	7.85	4.17	1.88	1.72	2.51	$19 35
6410	Blood & Bone	J. B. Gray & W. W. Gulledge, Ohatchie	7.10	2.86	3.44	1.19	1.99	15 28
6412	Read's Blood & Bone No. 1	T. R. Farish & Bros., Clayton, Ala	7.25	8.93	1.42	1.30	2.58	17 35
6415	Aurora Am. Phosphate	Jas E. Snead, Snead, Ala	5.85	8.32	1.38	1.64	1.90	15 66
6416	Animal Bone Fertilizer	" " " "	7.20	4.00	6.10	1.75	1.78	17 88
6419	A. A. P. Bone with Ammonia	" " " "	7.35	4.51	1.14	1.35	1.46	17 10
6420	W. O. C. Guano	" " " "	8.30	4.47	1.48	2.22	2.62	21 61
6421	Sea Bird Guano	" " " "	7.90	2.93	6.82	1.64	2.22	17 64
6422	Coweta H. G. Fertilizer	" " " "	8.30	5.51	5.44	1.72	1.95	20 58
6424	Sea Gull Compound	R. W. Allen & Co., LaFayette, Ala	8.00	2.75	2.30	1.00	2.84	15 89

6425	Georgia Formula	R. W. Allen & Co., LaFayette, Ala	7.70	8.07	2.18	1.44	2.40	17.20
6428	Am. Dis. Bone	J. R. G. Howell, Dothan, Ala	7.70	5.41	1.54	.98	2.99	18.84
6429	Howell's Fruit Food	" "	4.25	8.88	.82	8.16	8.81	19.79
6431	Beef, Blood & Bone Guano	Weathers, Swan & Co, Roanoke, Ala	7.90	8.45	1.80	1.12	1.23	15.72
6432	Solid South Guano	" "	7.90	8.30	8.00	1.58	2.24	17.86
6434	Tuskaloosa Guano	Tuscaloosa C. S. Oil Co., Tuscaloosa, Ala	8.30	8.54	.26	2.16	2 86	20.25
6436	Goulding's Bone Compound	Hughes Bros., Florala, Ala	6.90	4.08	5.32	1.48	2.05	17.17
6438	Potapsco Guano	R. W. Allen & Co., LaFayette, Ala	8.55	2.89	1.96	1.86	2.82	17.57
6445	Hume's Am. Dis. Bone	Troy Fertilizer Co., Troy, Ala	8.45	8.13	2.42	1.68	2.32	18.60
6447	Troy Perfect Guano	" "	7.80	8.32	2.68	1.48	2.11	17.87
6448	Blood and Bone Guano	" "	8.05	8.63	2.32	1.62	2.84	18.56
6449	" "	" "	8.55	2.77	2.18	1.64	2.57	18.48
6453	Complete Cotton Fertilizer	P. J. Ham & Son, Elba, Ala	7.85	1.88	8.22	2.00	2.4	17.70
6454	Jones Special Formula	" "	8.85	2.65	1.50	1 22	4.02	18.54
6455	Merriman's Cotton Boll Guano	" "	9.95	1.38	2.32	1.58	4.07	19.82
6456	" "	" "	10.05	1.46	1.94	1.34	8.38	18.59
6459	Blood, Bone and Potash	Hilton, Bentley & Cosby, Brantley, Ala.	10.00	2.53	1.72	.94	1.69	16.85
6460	Ga State Grange Fertilizer	" "	6.10	2.84	2.56	1.68	2.98	16.57

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6461	Jones Special Formula	Hilton. Bentley & Cosby. Bentley, Ala.	7.40	8.25	3.10	.95	3.88	17.19
6462	Sample No. 1	C. Kimbrough, Alexander City, Ala	8.20	3.36	1.94	2.06	2.88	20.21
6463	Sample No. 2	.. .. ..	7.05	3.12	1.38	2.43	1.53	18.50
6468	Troy Perfect Guano	J. T. Ramage, Brundidge, Ala.	7.55	2.79	3.26	1.94	2.65	18.42
6469	Star Guano	.. .. ..	6.75	3.58	5.22	2.28	1.55	18.21
6470	Sea Gull Guano	.. .. ..	7.00	5.25	4.10	1.84	2.68	20.08
6472	Blood Bone and Potash	W. F. Kenzie, Greenville, Ala	6.00	4.98	5.22	1.98	2.18	18.60
6473	Goulding's Special Compound	.. .. ..	7.05	3.07	7.08	1.56	2.90	17.89
6476	Alabama Guano	J. C. Akin & Son, Notasulga, Ala	7.10	3.77	1.28	2.16	2.36	19.28
6478	Ammo. Superposphate	First Bank of Elba, Elba, Ala	5.55	3.56	3.80	1.42	2.48	15.41

6479	Hume's Am. Dis. Bone	First Bank of Elba, Elba, Ala	7.85	2.81	4.44	1.24	2.02	15 65
6481	Patapsco Guano	T. K. Brantley & Son, Troy, Ala	8.00	3.14	1.96	.94	2.50	16 27
6482	Sea Gull Guano	" " " "	9.45	1.28	2.12	.98	2.58	15 95
6485	Baltimore Soluble Bone	J. G & John Sanders, Dothan, Ala	8.30	3.89	1.46	.51	1.57	13 76
6493	Georgia Formula	C. H. Butler, Childersburg, Ala	7.55	2.44	2.28	1.41	2.62	16 56
6495	Georgia State Grange	Burks & Coston, Brantley, Ala	7.20	2.47	.98	2.30	2.78	18 89
6497	Ox Cotton Grower	M. F. Patterson, Falkville, Ala	7.30	3.95	2.50	2.16	2.02	19 32
6498	Troy Perfect	Burks & Coston, Brantley, Ala	7.70	2.07	2.28	1.62	2.29	16 60
(108) 6499	Blood and Bone	" " " "	4.80	4 22	4.28	1.38	1.88	14 71
6502	Perfection Guano	McMillan & Harrison, Mobile, Ala	7.50	3.06	.74	2.64	3.57	21 82
6503	" "	Jess Jackson, Grand Bay, Ala	10.55	2.56	1.34	1.48	3.34	20 59
6505	Gossypium Phospho	W. S. Crass, Pelham, Ala	9.30	2.87	.78	1.54	2.71	18 69
6508	Big Hit	G. A. Sanders, Luverne, Ala	11.35	1.68	2.02	1.22	1.06	17 51
6509	Hume's Am. Dis. Bone	" " "	7.85	1.58	3.42	1.68	2.84	16 47
6513	Roanoke Guano	A. J. Pittman, Wehodkee, Ala	7.35	2.67	3.08	1.86	2.24	17 47
6514	Randolph Guano	" " "	7.30	3.60	2 80	1.83	2.14	18 16
6516	Beef, Blood and Bone	W. A. Gage & Co., Town Creek, Ala	8.65	4.15	1.30	1.80	2.21	19 05
6517	Helmet 282	" " " " "	2.90	8.92	.98	2.00	8.25	20 62

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6518	Helmet, 271	W. A. Gage & Co., Towne Creek, Ala	2.50	9.10	1.00	2.14	2.42	$20 01
6521	Old Dominion	Phillips Bros, Oxford, Ala	4.05	4.60	2.20	1.92	3.24	17 27
6522	Talladega Am. Dis. Bone	" " " "	6.65	3.00	0.20	2.06	3.38	18 80
6524	Ga. State Standard Guano	Ingram & Co., Anniston, Ala	8.65	2.71	1 41	1.56	2.18	17 98
6527	Eddystone Soluble Guano	J. Markentepe, Cullman, Ala	6.75	4.24	2.66	2.10	1.80	17 67
6528	Fertilizer	Robbins & McGowan, Brewton, Ala	8.95	2.05	2.80	2.18	2.36	19 46
6532	Schuessler & Co's Beef, Blood & Bone	Schuessler & Co., Roanoke, Ala	7.25	3.41	6.24	1.26	1.52	15 71
6533	" " Special Formula	" " " "	7.45	3.34	4.46	1.26	4.25	18 57
6534	" H. G. Fertilizer	" " " "	6.75	3.35	4.90	1.90	2.65	18 07
6538	Ala. Fertilizer	Britt & Johnson, Wetumpka, Ala	8.60	4.99	.56	2.10	2.60	22.07

6541	Hume's Am. Dis. Bone............	McEntyre, Henderson & Adams, Ozark.	7.80	2.95	2.20	1.92	2.80	18.48
6543	Troy Perfect Guano................	" " " "	6.70	2.84	8.66	1.26	3.28	15.85
6544	Goldsmith's Improved Mixture....	" " " "	6.15	3.65	2.10	1.67	1.96	16.44
6545	Swift's Eagle	" " " "	7.10	4.93	1.02	2.02	2.87	20.56
6547	Am. Dis. Bone....................	B. Bullard, Elba, Ala................	6.60	5.99	4.96	1.16	1.20	17.04
65 8	Crescent Guano	" " "	6.50	9.08	0.62	1.62	1.01	21.18
6550	XXX Blood & Bone Guano.........	George Kroell, Montevallo, Ala.......	8.00	3.66	2.24	1.54	1.60	17.57
5552	Farmers Alliance Guano...........	H. R. & H., Brantley, Ala.............	7.40	2.89	8.26	1.84	2.29	17.78
6553	Nancy Hanks Guano..............	" " " "	7.60	2.17	2.18	1.82	2.51	17.88
6554	Hume's Am. Dis. Bone...........	" " " "	7.20	2.89	2.46	2.10	2.81	18.28
6555	Troy Perfect..............	" " " "	7.90	2.67	8.08	1.94	2.12	18.12
6556	B. D. Sea Fowl Guano	" " " "	8.40	2.96	2.82	2.04	1.35	18.44
6557	Capital City Guano	" " " "	6.80	8.76	4.44	1.82	2.57	18.28
6461	B'ham Blood, Bone and Potash...	Geo. M. Truss & Co., Springville, Ala...	9.70	3.65	1.80	1.66	2.30	20.30
6563	Fertilizer........................	J. O. Hodges, Ashville, Ala............	8.10	3.52	1.98	1.68	2.85	19.17
6565	Bear Beef, Blood and Bone........	A. P. Howison, Randolph, Ala..........	7.60	4.58	2.02	2.28	2.47	21.08
6570	Ox Slaughter House Bone	W. W. Carlisle & Bro., Roanoke, Ala....	7.40	4.52	1.18	1.56	2.77	19.06
6578	Blood and Bone Guano............	" " " " "...	4.60	5.18	1.42	1.70	2.75	17.24

Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6574	Roanoke Guano	W. W. Carlisle & Bro. Roanoke, Ala	5.55	4.44	2.66	2.04	1.79	17.49
6575	Randolph Fertilizer	" " " " "	6.85	3.91	2.24	2.00	2.03	18.39
6579	Alabama Fertilizer	Sessions & Mizelle, Enterprise, Ala	6.75	5.52	1.38	1.86	1.59	19.07
6582	Helmet 271	T. A. Howle, Oxford, Ala	2.00	8.84	.66	1.98	1.67	18.05
6583	Georgia State Grange Guano	" " "	7.45	2.50	1.80	1.70	2.61	17.32
6584	Birmingham Guano	" " "	4.85	4.17	1.48	1.14	1.75	18.96
6588	Tip Top	T. J. Land, Cullman, Ala	9.65	2.83	2.32	1.02	1.27	16.61
6590	Stern's Am. Raw Bone	Chapman & Co., Geneva, Ala	4.30	8.60	4.40	1.52	1.66	16.92
6501	Champion Farmers' Choice	" " " "	6.80	8.07	.88	2.14	1.64	17.50
6594	No. 8 Wet Guano	J. S. Collins, Geneva, Ala	7.85	5.24	1.86	1.44	1.70	18.32

6597	Mobile Standard	Crutcher & Ward, Cuba, Ala	5.40	5.10	6.40	1.65	2.24	17.86
6599	Helmet Brand	M. P White, Attalla, Ala	1.45	8.97	.58	2.26	1.87	18.62
6601	Scott's Animal Am. Dis. Bone	W. J. Sibert, Gadsden, Ala	7.50	2.98	2.82	1.64	1.55	16.62
6603	Mobile Standard Guano	Chas. Ivey, Evergreen, Ala	5.65	4.60	6.10	1.72	2.11	17.18
6605	Blood and Bone	Zena Shepherd, Georgiana, Ala	6.45	3.64	4.16	1.51	2.15	16.47
6608	Alliance Soluble Guano	J. I. Covington, Bertha, Ala	6.50	4 27	3.38	1.78	2.01	17.76
6609	Rock City	J. E. F. Westmoreland, Florence, Ala	6.95	3.48	1.12	1.50	1.75	16.38
6610	Pacific Guano	" " " "	7.40	4.28	5.02	1.18	1.84	16.77
6611	Armour's 722	J. A. Kenney, Loop, Ala	4 05	9.47	4.28	1.48	2.22	19.88
6616	Corn and Cotton Guano	J. C. Hartselle & Son, Hartselle, Ala	5.85	5 41	4.24	1.14	1.68	16.13
6619	King Cotton Grower	W. A. Shaw, Winfield, Ala	5.30	4.43	4.12	1.15	2.08	14.98
6621	Crescent Guano	C. R. Waxwell, Northport, Ala	6.30	3.38	4.12	1.68	1.86	16.24
6622	Maxwells' Home Mixture	" " " "	6.55	2.78	0.42	1.96	1.97	16.79
6624	Baltimore Soluble Bone	Bean & McMurray, Heflin, Ala	8.90	4.39	1.26	.55	......	13.79
6626	Bear, Beef Blood and Bone	" " " " "	7.70	5.14	.86	1.88	2.12	15.82
6631	Ox Cotton Guano	Franzen & Olsoo, Thorsby, Ala	8 00	4.35	2.10	1.78	1.50	18.83
6633	B'ham Dis Bone Am. and Potash	T. U. Crumpton, Maplesville, Ala	9.05	4.49	.66	.56	1.59	16.17
6634	Star Brand	S. N. Rains, Elba, Ala	6.60	4.46	5.34	2.10	1.70	18.64

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Acid Phosphate with Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial value.
6635	Blood Formula	W. E Crass, Pelham, Ala	7.45	4.04	4.76	.86	1.95	$15.85
6637	Complete Fertilizer	John Ward, Headland, Ala	2.60	2.21	.84	.82	1.58	8.64
6640	Blood, Bone and Potash	Asa Griffith, Hanceville, Ala	7.95	3.00	2.30	1.54	1.74	17.00
6641	Beef, Blood and Bone	" " " "	7.95	3.98	1.22	1.88	2.06	19.25
6642	" "	" " " "	6.85	6.55	1.85	1.78	2.17	20.55
6643	Tatapsco	" " " "	9.00	3.00	2.25	1.05	1.92	16.86
6647	Meridian Blood and Bone	G. H. Amos, Duck Spring, Ala	7.55	3.10	2.00	2.00	2.30	18.55
6648	" Home Mixture	" " "	8.05	2.90	1.90	1.68	2.25	17.90
6619	Armour's 272	W. T. Andrews, Gold Hill, "	1.35	6.84	6.76	2.16	2.67	16.91
6650	Helmet 272	" " "	2.40	8.55	1.50	2.20	2.78	19.89

6651	Ox Cotton Guano	W. T. Andrews, Gold Hill, Ala.	8.90	8.05	2.05	1.82	1.76	18 81
6653	Blood, Bone and Potash	F. D. Byrum, Byrum, Ala.	8.05	4.00	1.80	.98	1.23	16 02
6654	Georgia State Grange Guano	" " "	7.90	2.50	2.20	1.78	2.70	18 08
6656	A. G. Winkler's Am. Dis. Bone	A. G. Winkler, Greenville, Ala	6.70	2.70	6 25	2.18	2.02	17 52
6658	Am. Dis. Bone.	Jno. H. Wilson, Jenifer, "	8.80	2.00	0.40	1.46	2.13	16 52
6664	Mobile Standard	W. W. Burnette, Geneva, "	6 80	7.10	.90	1.84	2.34	21 69
6668	Scott's Gossypium Phospho	Lull & Lacy, Wetumpka, "	9.45	2.65	1.15	1.66	2 41	19 21
6669	" Blood Formula	" " "	8.20	8.26	1.76	1 09	1.95	16 46
6672	" AA	D. D. Hughes, Lebanon, "	7.30	5.85	2.70	1.70	1.45	18 86
6674	" Blood Formula	" " " "	6.90	9.87	1.76	.96	1.25	20 71
6677	No. 271	Cash Supply Co., Mountain Creek, Ala.	3.60	8.56	.74	2.50	2.10	21 26
6678	Alabama Fertilizer	" " " " " "	6.25	4.02	1.76	2.10	2 34	18 49
6679	Georgia Farmer	J. G. Land, Cullman, Ala.	5.05	4.05	3 00	1.56	2.12	15 59
6680	Scott's	Joel W. Ligg. Elkmont, Ala	7.00	2.95	2.80	1.76	1.59	16 47
6686	XXX Am. Dis. Bone	Trawick & Jernigar, Opelika, Ala	5.45	4.62	3.28	1.52	2.31	16 64
6687	XX Blood and Bone	" " " "	5.55	4.78	3.42	1.68	2.06	17 04
6688	Old Time Guano	" " " "	5.50	3.80	4.10	1.64	2.48	16 37
6689	Lee Fertilizer	" " " "	6.45	3.86	1.84	1.64	2 55	17 45

Analyses Reported by State Chemist from July 1st, 1900 to July 1st, 1901.

Acid Phosphate with Nitrogen and Potash—Continued.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid.			Nitrogen.	Potash.	Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6633	Alabama Fertilizer	W. D. Brown, Gravilla, Ala	7.70	2.50	1.50	2.06	2.04	18 01
6694	Mobile Standard Guano	" " "	8.85	5.25	6.25	1.92	1.98	16 41
6697	Eddystone Soluble Guano	Coley & Sandlin, Alex. City, Ala	7.00	5.29	0.70	1.48	1.88	18 06
6698	Magic Cotton Grower	" " " " "	7.40	2 65	1.80	1.13	2.38	15 59
6700	Special Blood Mixture	" " " " "	5.60	4.20	1.25	.92	1 58	13 96
6703	Goulding's Bone Compound	W. D. Brown, Gravilla, Ala	8.40	6.25	.90	1.70	.91	20 82
6706	Cahaba Dis Bone Am. & Potash	White & Spigener, Goodwater, Ala	9.30	4.95	1.80	.78	1.82	17 75
6707	" H. G. Blood, Bone & Potash	" " " "	7.75	8.80	1.35	1.55	2 04	17 98

6709	Standard Guano	White & Spigener, Goodwater, Ala	7.00	8.18	0.60	1.88	1.68	15 64
6710	Boss Cotton Grower	" " " "	7.10	5.05	2.45	.84	1.98	16 48
6224	B'ham Dis. Bone, Am. & Potash	Birm'ham Fert Co., Birmingham, Ala	10.00	8.88	.87	.90	1.05	17 [illegible]
6225	B'ham H. G. Fertilizer	" " " " "	10.23	8 85	.87	1.87	2.22	21 04
6225	Cahaba H. G. Fertilizer	" " " " "	10.23	8.85	.87	1.87	2.22	21 04
6712	Merriman's Cotton Boll Guano	W. C. Perry, Seale, Ala	5.20	6.55	1.55	1.89	1.82	17 46
6714	Troy Perfect	Ben. Jennings, Seale, Ala	6.65	2.65	2.90	1.62	1.86	15 [illegible]
6717	Eddystone Soluble Guano	W. H. Bynum, Boaz, Ala	7 30	5.90	2.10	1.44	1.71	18 94
6719	Blood & Bone	J H. Myers, Langstone, Ala	7.25	4.15	5.70	.59	1.91	14 96
6720	Patapsco Guano	Bean & McMurry, Heflin, Ala	8.10	8.85	1.75	.82	2.76	17 01
6724	Blood, Bone & Potash	McEntire, Henderson & Adams, Ozark	5.80	5.00	5.60	1.96	1.77	17 56
6725	Eddystone Soluble Guano	Elrod & Gibson, Collinsville, Ala	6.15	5.59	3.06	1.94	1.53	18 70
6726	No. 1 Guano	W. H. Mizelle, Grimes, Ala	6.80	1.69	3.06	1.46	2.06	14 64
6727	No. 3 Guano	" " "	7.15	4.79	1.36	2.12	2.08	19 91
6730	Magnet Soluble Guano	Davis, Marshall & Co., Mobile, Ala	6.70	4.55	1.85	2.20	2.18	19 54
6734	Beef, Blood & Bone	R. F. Gilbert, Porterville, Ala	6.65	5.48	1.22	.73	1.58	15 65
6735	Magic Cotton Grower	" " "	5.80	6.11	1.44	.90	2.01	16 54
6738	Alabama Guano	Gunter & Ealem, Gantt, Ala	6.50	8 54	8.16	1.88	1.90	17 20

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Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Warter Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6739	Old Homestead	Gunter & Ealem, Gantt, Ala	8.45	8.60	8.10	1.00	2.29	$17 18
6740	Meal Mixture	" " " "	6.10	3.90	2.10	1.98	2.06	17 20
6741	Pike Pride	" " " "	7.60	3.56	1.04	1.54	2.27	17 74
6744	Cow Guano	McEntire Bros., Cullman, Ala	5.70	3.08	5.02	1.78	2.20	15 91
6745	Corn and Cotton Guano	" " " "	8.10	.83	5.72	.74	2.25	13 25
6747	Blood and Bone Guano	S. W. Henry, Springville, "	6.00	4.48	4.82	.86	2.00	14 98
6748	Fertilizer	J. C. Alford & Son, Childersburg, Ala	6.75	6.57	2.98	1.66	1.77	19 74
6751	Farmer's Special Manure	R. Q. Edmonson & Bros., Eufaula, Ala	7.45	4.90	1.10	.74	2.81	17 23
6753	282	F. L. Johnson & Co., Gadsden, Ala	2.25	7.60	2.35	2.10	2.18	17 91
6754	Complete Fertilizer	E. J. Neher, Hollywood, Ala	4.60	4.50	4.90	.80	2.18	13 74

6762	S. &. K. Am. Dis. Bone............	Opelika Chemical Co. Opelika, Ala......	7.05	4.30	6.30	1.30	1.30	16.29
6768	Blood and Bone Guano.............	" " " " "	7.05	3.85	3.90	2.26	1.66	18.39
6769	Alliance Soluble..................	" " " " "	7.50	3.19	4.76	2.14	2.13	18.81
6770	C. C. C. Standard Fertilizer........	" " " " "	7.55	3.84	4.56	2.24	2.01	19.67
6771	Star Brand Guano..................	" " " " "	7.15	3.03	4.82	1.72	1.25	16.25
6772	Pinkard's Home Mixture.	" " " " "	5.45	3.39	1.06	2.40	1.90	17.46
6773	Meal and Phosphate Compound....	" " " " "	7.90	5.00	1.20	2.64	.72	21.01
6774	Good Luck Soluble Guano..........	" " " " "	6.95	4.23	6.62	1.28	1.18	15.94
(118) 6775	Diamond Soluble Guano.	" " " " "	7.05	3.30	4.90	2.08	1.27	17 44
6776	Schuessler Bros.' H. G. Guano.....	" " " " "	7.45	2.82	5.08	1.98	1.81	17.12
6777	Schuessler & Co's Beef, Blood & B'ne	" " " " "	7.05	3.73	6.22	1.28	1.45	15.81
6778	" " Special Formula...	" " " " "	6.55	4.10	3.80	1.38	2.14	17.65
6779	" " H. G. Fertilizer...	" " " " "	7.85	3.47	4.78	2.26	2.00	19.65
6809	Sea Gull Soluble Guano............	W. B. Wilhite, Hartselle, Ala..........	6.50	2.88	4.82	1.66	2.19	16.22
6810	Capital City Standard Fertilizer....	" " "	6.20	6.08	1.02	1.60	2.29	19.00
6791	Am. Dis. Bone.....................	Montgomery Fertilizer Co., Montgom'y.	7.00	3.96	5.54	1.24	1.51	15.94
6792	Vandiver's Am. Dis. Bone.........	" " " "	6.50	3.93	7.12	1.29	1.36	15.40
6793	Montg'y Blood and Bone Guano....	" " " "	7.60	3.45	4.80	2.20	2.32	19 53

Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.

Acid Phosphates with Nitrogen and Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6794	Southern Pacific Guano............	Montgomery Fertilizer Co., Montgom'y.	7.35	8.33	5.82	1.26	1.56	15.77
6795	Plow Brand Soluble Guano.........	" " " "	7.25	4.52	4.28	1.21	1.50	16.66
6796	Tariff Reform Soluble Guano......	" " " "	7.70	2.11	5.84	2.26	2.18	18.32
6797	Early Bird Soluble Guano..........	" " " "	7.75	8.16	5.24	1.28	1.19	15.68
6798	Our Cotton Queen Guano...... ...	" " " "	6.70	6.82	3.18	1.28	1.80	18.90
6799	Capital City Standard Guano..	" " " "	7.50	3.83	4.92	2.28	2.74	20.45
6800	Willson's Special Compound........	" " " "	8.30	3.74	3.96	1.52	1.67	17.97
6802	Planters Pride Guano.............	West & McMurray, Roanoke, Ala.......	6.95	8.27	2.98	1.55	2.11	16.67
6805	Sea Gull Soluble Guano............	Montgomery Fertilizer Co., Montgom'y.	7.70	8.33	4 62	2.24	2.55	19 85
6806	Crescent Guano....................	" " " "	7.55	8.27	4.68	2.06	1.52	18.09

6807	Clayton Fertilizer	Montgomery Fertilizer Co., Montgom'y.	5.50	3.66	.94	2.40	3.41	19.89
6813	Am. Dis. Bone	C. W. Bell & Son, Lineville, Ala	9.20	.54	3.86	1.92	2.87	17.49
6817	Baltimore Soluble Bone	G. W. Roberts & Co., Collinsville, Ala	7.90	4.11	1.54	1.14	1.85	17.05
6818	H. G. Patapsco Guano	" " " "	9.20	3.06	1.84	1.40	1.78	17.96
6814	Blood, Bone and Potash	C. W. Bell & Son, Lineville, Ala	5.90	6.80	7.30	.06	2.01	14.83
6819	Alabama Fertilizer	W. A. Arnold, Ozark, Ala	8.60	2.40	1.80	1.92	1..7	18.15
6820	Dale County Standard	" " "	8.70	3.91	.74	2.30	1.97	21.12
6822	Solid South Guano	Reeves, Sanders & Co., Heflin, Ala	6.55	3.78	2.92	1.54	1.92	16.71
6823	Am. Dis. Bone	W. F. Vandiver & Co., Montgomery, Ala.	7.15	3.87	5.08	1.48	1.74	16.78
6825	Helmet Brand 271	F. E. King & Co., Leighton, Ala	1.55	10.10	.60	2.04	1.47	18.83
6826	Alliance Soluble Guano	J. C. Pinkston, Shorter, Ala	6.60	3.64	5.06	1.76	2.01	17.02
6829	Goulding's Bone Compound	F. A. Gulledge, Verbena, Ala	6.20	4.22	4.28	1.29	2.85	16.88
6833	Patapsco Am. Dis. Bone	White & Aubry, Roanoke, Ala	7.10	3.44	2.66	1.78	2.02	17.54
6834	Patapsco H. G. Guano	" " " "	8.65	2.91	1.94	1.28	2.08	16.22
6835	Sea Bird Guano	" " " "	7.20	4.57	1.78	1.68	2.34	18.81
6836	Sea Gull Guano	" " " "	8.35	1.58	2.22	1.34	1.89	15.52
6837	W. O. C. Pure Blood Guano	" " " "	6.75	4.37	1.48	1.74	2.13	18.02
6839	Bear Beef, Blood and Bone	A. B. Vandigrift & Son, B'ham, Ala	7.70	4.78	1.62	1.68	2.67	19.85

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Nitrogen and Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6840	Helms Bone, Blood and Potash No. 8	Helm Bone Fertilizer Co., B'ham, Ala.	0.00	6.09	4.86	2.12	2.78	14.81
6841	Helms Bone, Blood and Potash No. 4	" " " " " "	0.00	4.29	5.26	1.92	2.18	11.81
6843	Mobile Standard	E. H. & A. S. Murdock, Coffee Springs.	8.15	5.69	5.16	1.96	2.20	16.53
6845	Dismond Guano	Cameron Bros, Notasulga, Ala	5.70	4.66	5.84	1.90	1.38	17.01
6847	Bear Beef, Blood and Bone	T. L. Neighbors & Bros, Goodwater, Ala.	7.65	8.12	1.88	2.10	2.42	19.07
6848	Champion Farmers' Choice	R. S. Pilley, Georgiana, Ala	6.70	3.85	3.90	1.86	2.20	17.96
6851	Complete Fertilizer	F. E. Oliver, Hyatt, Alabama	0.00	8.90	6.28	1 74	2.76	11.58
6854	Sea Foul Guano	W. J. Mullins, Clanton, Ala	7.50	8.83	1.12	1.88	1.72	18.81
6855	Alabama Fertilizer	" " " "	7.35	2.65	1.70	1.88	1.78	17.04
6857	Magic Cotton Grower	West & McMurry, Roanoke, Ala	6.90	8.58	1.72	0.90	1.28	14.28

6860	No. 8. Eddystone Solublo Guano...	Montgomery Bros., Lincoln, Ala......	6.30	3.94	.96	2.60	1.83	19.35
6862	Bear, Beef, Blood and Bone.........	J. T. Tabor, Keener, Ala.......	7.70	4.47	.88	2.04	1.74	19.62
6867	Scott's Gossypium Guano	Haley Bros., Haleyville, Ala...........	9.05	2.60	2.40	1.92	2.84	19.87
6868	Scott's Blood Formula.............	" " " "	9.50	3.97	1.48	1.02	1.42	17.75
6869	Bear Guano.......................	" " " "	8.45	4.35	2.70	2.00	2.13	20.58
6870	Florence King Cotton Guano......	" " " "	3.90	4.47	5.08	1.44	2.08	14.48
6872	Howle Bros. Bone Compound.....	Howle Bros., Wetumpka, Ala..........	6.80	3.99	6.86	1.74	1.84	17.50
6874	Ozark Guano No. 2................	Ozark C. S. O. M. and Fert. Co., Ozark.	6.75	5.99	1.26	2.80	1.63	20 81
9876	Blood, Bone and Potash Guano....	E. P. Duncan, Alexander City, Ala....	5.60	5.64	4.76	1.84	1.20	17.59
6877	Georgia State Grange..............	" " " " "	5.35	3.40	1.80	1.10	3.48	15.31
6879	New Brand No. 721................	J. H. Henderson, Cross Keys, Ala......	4.65	6.49	9.36	1.82	1.04	14.00
6880	Am. Bone	S. J. Baird, Guin, Ala..................	9.85	7.11	5.24	0.11	.43	17.70
6882	King Cotton Grower..............	J. H. Karter Co., Cullman, Ala.........	4.80	5.80	5.50	.84	1.42	14.87
6883	Bear Guano.......................	" " " " "	11.40	5.88	1.22	.04	0.00	17.28
6885	Soluble Guano.....................	T. H. McEntyre, Coffee Springs, Ala. ..	2.25	7.95	7.50	1.21	1.20	14.79
6889	Eagle Am. Bone....................	L. O. Cox, Boaz, Ala...................	6.65	4.25	2.70	1.72	2.32	18.04
689C	Eagle Guano.......................	L. O. Cox, Boas, Ala..................	8.10	4.15	2.60	1.90	1.97	19.54
6891	Helmet Brant No. 271.............	J. H. Henderson, Cross Keys, Ala......	1.90	8.02	.98	2.02	1.80	17.38

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Acid Phosphate with Nitrogen and Potash—Concluded.

Station No.	Name of Fertilizer.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial value.
6892	Helmet Brand No. 272	J. H. Henderson, Cross Keys, Ala.	2.70	7.88	1.02	2.38	2.31	$19.55
6893	" " " 285	" " " "	2.00	8 07	2.48	2.00	5.46	21.13
6894	African Cotton Grower 292	" " " "	2.75	11.09	1.36	2.90	2.92	24.86
6896	Eddystone	M. Noble, Avery, Ala.	7.30	4.58	1.72	1.82	1.67	18.55
6898	Beef Blood and Bone	Reeves, Landers & Co, Heflin, Ala	7.20	4.27	1.98	.98	1.62	15.83
6901	Old Hickory Guano	T. B. Williams, Cullman. Ala	7.45	2.86	3.34	1.98	1.75	17 60
6902	Am. Dis. Bone Guano	" " "	8.15	4.70	5.50	.44	2.23	16.31
6903	Complete Fertilizer	J. C. Hensley, " "	5.70	3.82	4.28	1.58	2.38	16.32
6909	Coley & Sandlin's Special Guano	Tallapoosa Oil Co., Alexander City, Ala.	6.90	3.50	.50	1.48	2.04	16.58
6910	Cotton Queen Guano	" " " " " "	5.65	2.72	.78	2.10	2 35	16.60

6911	Standard Guano....................	Tallapoosa Oil Co., Alexander City, Ala.	6.60	3.16	.64	1.52	2.20	16.22
6012	Soluble Guano....................	" " " " " "	6.25	3.36	.54	2.10	2.26	17.75
6913	Waters' Special Guano............	" " " " " "	6.40	3.10	1.00	1.52	2.18	15.89
6225	Cahaba H. G. Blood, Bone & Potash	Birmingham Fertilizer Co., B'ham, Ala.	10.28	3.35	.37	1.87	2.22	21.04
6225	Earle, Terrell & Co's. H. G. Fert'r..	" " " " "	10.28	3.35	.37	1.87	2.22	21.04

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates with Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Warter Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial Value.
6222	B'ham Acid Phos. & Potash Mixture.. ..	B'ham Fertilizer Co., Birmingham, Ala...	8.80	8.35	0.30	2.18	16.33
6223	B'ham Potash Bone	.. ..	7.78	4.92	.56	3.59	16.24
6237	Acid Phosphate & Potash..............	Troy Fertilizer Co., Troy, Ala............	7.00	1.97	3.66	3.39	12.33
6250	Dis. Bone & Potash.....................	.. ..	6.85	1.51	3.64	3.90	12.20
6265	B'ham A. P. & Muriate of Pot. Mixt.....	B'ham Fertilizer Co., Birmingham, Ala...	10.40	5.08	.22	2.51	17.94
6266	.. .. and Potash Mixture.......	.. ..	7.60	6.30	.40	2.26	16.16
6267	B'ham Bone Ash.	.. ..	9.05	4.27	.38	4.30	17.62
6268	B'ham Potash Bone	.. ..	9.40	4.62	.38	4.13	18.15
6278	B'ham Acid Phos. and Potash	.. ..	10.20	3.77	.48	1.41	15.38
6280	Acid Phosphate and Potash.............	W. Andrews, LaFayette, Ala.............	8.35	3.82	.58	4.41	16.38

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6295	" " "	W. Andrews, LaFayette, Ala	8.20	3.88	.72	4.89	16.92
6299	Coweta Dis. Bone & Potash	Herren & Oliver, Dadeville, Ala	12.45	3.48	.62	1.98	17.86
6300	" " " " "	" " " "	6.95	4.98	2.12	3.18	15.06
6301	" H. G. Dis. Bone & Potash	" " " "	11.25	3.09	.56	2.18	16.47
6302	Coweta Standard	" " " "	9.00	3.52	.58	4.28	16.80
6310	Acid Phos. & 4% Potash	McGhee, Driver & Co., LaFayette, Ala	.65	9.00	1.50	4.56	14.21
6311	Dis. Bone & Potash	" " " " "	7.60	5.83	3.12	1.84	14.77
6312	Bone & Potash	" " " " "	10.20	5.44	1.36	1.09	16.78
6315	Stono Acid & Potash	R. A. Russell. & Co., Gaylesville, Ala	5.15	9.36	1.14	2.49	18.00
6324	Bone & Potash Phosphate	Wright, Henderson & Co., Elba, Ala	8.75	2.36	1.54	3.39	14.51
6329	Dixie Acid Phos. & Potash	Jno. A. Nicholls, Childersburg, Ala	6.30	6.98	.52	2.41	15.69
6330	Cahaba Acid Phos. & Potash	" " " "	10.25	4.83	.52	1.26	16.84
6333	B'ham Acid Phos. & Potash Mixture	Lester & Co., Columbiana, Ala	9.45	4.45	1.00	1.01	14.91
6336	8 and 4	H. M. Beach & Son, Columbia, Ala	8.55	1.99	.86	4.87	15.41
6344	Bone & Potash	T. C. Masterson, Aorca, Ala	9.50	6.18	3.02	.24	15.92
6349	Marietta Guano Co's H. G. Dis.Bone	Reynolds Bros., Jemison, Ala	8.30	4.01	1.84	2.21	14.52
6351	Bone & Potash Acid	Campbell & Wright, Jr., Roanoke, Ala	9.60	2.01	3.44	2.17	13.78
6352	Potash Acid	" " " "	8.95	2.37	3.68	2.52	13.84

Analyses Reported by the State Chemist from July 1, 1900 to July 1, 1901.

Acid Phosphates with Potash—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial Value.
6382	Ashcraft's Formula	W. D. Hamilton, Guin, Ala	5.05	5.47	4.88	2.03	12.55
6398	Teague's Bone and Potash	S. F. Teague, Birmingham, Ala	6.35	6.52	3.68	2.12	19.99
6411	Read's Alkaline Bone	T. K. Parish & Bro., Clayton, Ala	6.15	4.94	1.66	2.40	13.49
6413	Imperial	V. B. Atkins & Co., Selma, Ala	11.15	3.49	.76	.72	15.36
6417	Coweta H. G. Dis. Bone and Potash	Jas. E. Snead, Snead, Ala	9.35	6.84	.66	2.63	18 82
6418	13 and 4 Dis. Bone and Potash	" " "	8.15	6.76	3.64	4.42	19.83
6423	Patapsco Acid Phosphate	R. W. Allen & Co., LaFayette, Ala	9.85	5.64	1.26	1.11	16.60
6427	Phosphate with Potash	J. R. G. Howell, Dothan, Ala	7.00	4.15	1.30	3.76	14.91
6444	Acid Phosphate and Potash	Troy Fertilizer Co., Troy, Ala	9.55	3.52	2.48	5.51	18.58
6446	Dis. Bone and Potash	" " " " "	9.40	2.85	2.60	5.98	18.23

6452	Ga BonCompound	P. J. Ham & Son. Elba, Ala.	7.95	8.09	.56	8.75	14.79
6458	Bone and Potash Acid Phosphate	Hilton, Bentley & Cosby, Brantley, Ala.	11.65	1.17	.78	2.88	15.65
6475	Opelika Phosphate and 2% Potash	J. C. Akin & Son, Notasulga, Ala.	6.25	4.91	5.14	2.05	13.21
6480	Patapsco Phosphate	T. K. Brantley & Son, Troy, Ala.	10 50	3.12	1.08	1.91	15.58
6483	" " 1% Potash	J. G. & John Sanders, Dothan, Ala	9.90	3.35	2.00	1.97	15.22
6484	Acid Phosphate with 4% Potash	" " " " "	1.80	7.49	1.26	5.86	15.15
6489	Acid Phosphate and Potash	First Bank of Elba, Elba, Ala.	7.90	3.28	2.12	3.48	14.61
6490	B'ham Dis. Bone and Potash	C. H. Butler, Childersburg, Ala.	9.30	2.76	1.74	1.08	13.14
6491	Acid Phosphate and Potash.	" " " "	10.20	3.81	2.04	1.66	15.17
6492	B'ham Acid Phos. and Potash	" " " "	11.05	2.37	.68	2.32	15.74
6510	"Guano"	W. A. Sims, Elrath, Ala.	1.45	8.76	1.94	1 14	11.85
6512	Potash Acid	A. J. Pittman, Wehodkee, Ala.	8.00	4.18	1.02	2.51	14.75
6520	Dis. Bone and Potash	Phillips Bros., Oxford, Ala.	8.05	5.84	.86	3.86	17.75
6525	Tenn. Special Wheat Grower	Ingram & Co., Anniston, Ala.	1 45	10.20	1.90	6.08	17.68
6531	S. & Co's H. G. Bone and Potash	Scheussler & Co., Roanoke, Ala.	5.05	4.79	5.96	1.97	11.81
6535	Sample No 1	W. W. Hicks & Co., Dadeville, Ala.	7.85	4.99	1.66	1.77	14.61
6536	Bear Brand Potash Mixture	Britt & Johnson, Wetumpka, Ala.	5.80	5.25	5.60	3.49	14.54
6540	Dis. Bone and Potash	McEntyre, Henderson & Adams, Ozark	9 00	3.47	1.68	4.08	16.55

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Acid Phosphate with Potash—Continued.

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Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Commercial value.
6542	Dis. Bone and Potash	McEntyre, Henderson & Adams, Ozark	8.60	5.97	2.18	4.11	$13.68
6559	B'ham Acid Phos and Potash Mixture	Geo. M. Truss, Springville, Ala	10.75	6.28	.32	2.64	19.67
6560	B'ham Acid Phos with Potash	.. .. ..	12.00	3.21	.44	2.35	17.56
6571	Bone and Potash Mixture	M. W. Carlisle & Bro., Roanoke, Ala	5.55	6.04	8.56	1.77	13.36
7572	Ox Potash Mixture	.. .. ..	7.30	4.75	6.00	2.22	14.27
6577	Acid Phos with Potash	Sessions & Mizell, Enterprise, Ala	4.35	5.45	4.50	3.75	13.55
6578	Alkaline Bone with 2% Potash	.. .. ..	6.50	4.80	4.36	3.07	14.37
6581	Bone and Potash	T. A. Howle & Co., Oxford, Ala	8.95	4.48	.72	2.21	15.59
6607	Phosphate 2% Potash	J. I. Covington, Bertha, Ala	5.80	5.82	1.68	2.19	13.81
6618	"Complete Fertilizer"	Burns & Beaver, Lincoln, Ala	7.80	3.97	4.78	2.19	13.96

6617	Tiger Brand Guano	J. C. Hartselle & Son, Hartselle, Ala	4.85	6.12	4.78	2 48	13.45
6625	Bear Bone and Potash	Bean & McMurray, Heflin, Ala	4.45	7.00	6.90	2.12	13.57
6628	Eddystone Bone and Potash	Elsod & Gibson, Collinsville, Ala.	10.15	6.82	1.98	1.56	18.03
6665	Scott's H. G. [and Potash]	Lull & Lacey, Wetumpka. Ala	6.95	5.0.	.68	2.22	14.19
6667	Pure Dis. Bone and Potash	.. .. ..	9.80	2.80	.90	1.52	14.22
6683	No. 1	Trawick & Jernigan, Opelika, Ala	8.85	4.84	2.96	2 45	14.54
6684	No. 2	.. .. ..	8.80	3.75	3.30	2.88	14.93
6685	No. 3	.. .. ..	8.70	3.96	3.74	3.52	16.18
6695	Marietta H. G. Acid Phos. and Potash	Coley & Sandlin, Alexander City, Ala	6.20	4.70	1.65	2 31	13.21
6696	Water's H. G. Dis. Bone and Potash	.. .. ..	4.00	4.25	90	2.23	10.48
6699	Cotton Queen	.. .. ..	6.00	4.80	2.00	2.00	12.80
6705	Cahaba Acid Phos. and Potash Mixture	White & Speigner, Goodwater, Ala	12.75	4.20	.70	1.71	18.66
6713	Dis. Bone and Potash	Ben. Jennings, Seale. Ala	7.95	3.45	1.10	3.34	14.74
6716	Eddystone Bone and Potash	W. H. Bynum, Boaz, Ala	4.40	7.40	5 50	2.13	13.93
6723	"Guano"	J. I. Brewer, Tabor, Ala	9.90	3 40	2.20	1.48	14.78
6728	No. 1	J. E. Smith, Stroud, Ala	4.95	7.39	.76	2.21	14.55
6733	Dis. Bone with Potash	R. F. Gilbert, Porterville, Ala	5.75	6 39	.56	1.56	13.70
6737	Dis. Bone and Potash	Gunter & Ealam, Gantt, Ala	6.50	3.94	3.46	2.73	13.17

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Acid Phosphate with Potash.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid.			Potash.	Commercial Value
			Water Soluble.	Citrate Soluble.	Acid Soluble.		
6750	Special Potash Mixture	R. Q. Edmonson & Bro., Eufaula, Ala	5.00	4.92	4.08	4.12	14.04
6752	No. 10—4's	T. L. Johnson & Co., Gadsden, Ala	6.70	5.18	2.42	3.87	15.20
6763	Opelika Acid Phos. & 2% Potash	Opelika Chemical Co., Opelika, Ala.	6.85	6.06	2.28	2.17	15.09
6764	Potash Acid Phosphate	.. ..	7.75	6.95	1.80	2.02	16.72
6765	Schuessler Bro's. H. G. Bone & Potash	.. ..	7.00	5.25	2.50	2.28	14.48
6766	.. .. XXX	.. ..	8.20	6.18	2.4[illegible]	1.72	16.10
6767	.. & Co's H. G.	.. ..	7.00	4.40	2.80	2.41	14.11
6788	English Acid Phos, with 2% Potash	Montgomery Fertilizer Co., Mont'gy, Ala	6.95	6.83	2.42	2.34	15.62
6789	Montgomery Acid Phos. and Potash	.. ..	6.50	5.89	2.46	2.87	14.76
6790	Dis. Bone and Potash	.. ..	7.75	6.95	2.89	1.18	15.88

6804	Alkaline Acid Phos. 4% Potash	Montgomery Fertilizer Co., Mont'gy, Ala.	5.65	3.78	1 92	4.06	18.49
6816	4% Acid Phosphate	G. W. Roberts & Co., Collinsville, Ala.	.90	5.75	.80	4.25	10.90
6831	Potash Acid	White & Aubrey, Roanoke, Ala.	11.90	2.70	1.80	1.64	16.24
6832	Pa·apsco Bone & Potash	" " " "	7.00	4 20	1.50	2.67	14.87
6853	B'ham Potash Mixture	W. J. Mullins, Clanton, Ala.	8.15	4.86	.64	2.02	16.03
6859	No. 1 Eddystone Bone & Potash	Montgomery Bros., Lincoln, Ala	6.45	5.95	4.70	1.86	14.26
6863	Adair's Formula	Jno. T. Tabor, Keener, Ala.	6.85	6.31	1.84	2.22	15.88
6878	Howle Bros' Phos. & Potash	Howle Bros., Wetumpka, Ala.	10.05	5 18	2.12	1.16	16.81
6888	Eagle Dis. Bone & Potash	L. O. Cox, Boaz, Ala	5.75	6.50	6.20	1.00	13.25
6900	H. G. Bone & Potash	T. B. Williams, Cullman, Ala	8.50	4.66	7.14	1.59	12.75
6906	Tallapoosa Dis Bone and Potash	Tallapoosa Oil Co., Alex. City, Ala.	7.75	4.85	.70	2.00	14.60
6907	Our Best Fertilizer Bone and Potash	" " " " " "	7.60	4.75	0.40	1.68	14.03
6908	Coley & Sandlin's Special Bone & Potash	" " " " " "	7 85	4.94	.66	1.63	14.42
6222	Cahaba Acid Phos. & Potash Mixture	B'ham Fertilizer Co., Birmingham, Ala.	8.80	5.35	.80	2.18	16.38
6437	Bone & Potash	R. W. Allen & Co.. LaFayette, Ala.	8.55	3.67	2.08	2.80	15.02

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Acid Phosphate

Station Number.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6206	High Grade Acid	Ozark Cotton S. O. M. and Fert. Co. Ozark, Ala.	11.95	3.12	.96	15.07
6220	B'ham High Grade Acid Phosphate	Birmingham Fertilizer Co., Birmingham, Ala.	12.73	3.79	.20	16.52
6221	Birmingham Standard Grade Phosphate.	" " " " "	11.33	3.62	.23	14.95
6227	H. G. Acid Phospate (Light)	Ozark Cotton S. O. M. and Fert. Co., Ozark, Ala.	12 00	2.79	.44	14.79
6228	H. G. Acid Phosphate (Dark)	" " " " " " " "	12.30	4.24	1.76	16.54
6233	English Dis. Bone Phosphate	Troy Fertilizer Co., Troy, Ala	9.70	3.71	5.42	13.41
6234	Troy Acid Phosphate	" " " " "	9.20	3.44	5.04	12.64
6235	H. G. Acid Phospnate	" " " " "	9.40	3 26	4.94	12.66
6236	English Acid Phosphate	" " " " "	9.45	2.56	5.24	12.01
6252	Acid Phosphate	P. R. Tunstall, Mobile, Ala.	11.60	6.10	1.20	12.20

6253	Acid Phosphate	T. Y Connor, Tuskegee	11.30	5.90	1.00	17.20
6262	B'ham H. G. Acid Phosphate	Birmingham Fertilizer Co., Birmingham, Ala.	13.20	4.61	.84	17.81
6263	" " " "	" " " " "	12.55	4.07	.48	16.62
6264	" " " "	" " " " "	12.05	2.80	.10	14.85
6274	Acid	G. W. McKiny, Five Points, Ala	6.00	5.57	1.68	11.57
6276	Acid Phosphate	W. W. Mizell, Grimes, Ala	13.00	3.13	.22	16.13
6277	Phosphate	W. L. Patterson, Oswichee, Ala	5.25	3.77	1.78	10.02
6285	Acid Phosphate	W. J. Hulto, Abbeville, Ala	8.15	5.15	.90	13.30
(129) 6290	Oil Mill Phosphate	Dadeville Oil Mill, Dadeville, Ala	11.35	3.67	.48	15.02
6294	H. G. Acid Phoshpate	Troy Fertilizer Co., Troy, Ala	10.15	3.58	.52	13.73
6296	Acid	S. M. Day, Five Points, Ala	11.20	4.98	.42	16.18
6307	H. G. Acid Phosphate	V. M. Harris, Kent, Ala	10.15	7.46	1.64	17.61
6316	Stono Dis. Bone	R. A. Rssell & Co, Gaylesville, Ala	4.25	10.00	1.00	14.25
6319	Wando	" " " " "	10.70	4.18	.72	14.88
6320	Acid Phosphate	D. H. Lewis, Gordon, Ala	1.00	8.95	2.20	9.95
6321	Diamond	O. & C. P. Dumas, Arlington, Ala	12.30	3.22	.08	15.52
6322	Georgia State Grange Acid Phosphate	Wright, Henderson & Co., Elba, Ala	10.00	3.06	1.44	13.06
6323	Troy H. G. Acid	" " " " " "	11.20	1.96	4.74	13.16

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ACID PHOSPHATES—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6328	Montgomery Phosphate	Jno. A. Nicholls, Childersburg, Ala	11.50	4.32	.88	15.82
6332	P. & H. Royal Acid Phosphate	Sanders & Son, Columbia, Ala	11.50	3.35	1.10	14.85
6335	Acid Phosphate	H. M. Beach & Son, Columbia, Ala	13.00	2.53	.52	15.53
6343	Ox H. G. Dis. Bone	T. C. Masterson, Aorca, Ala	11.50	4.26	1.94	15.76
[illegible]46	Scott's H. G. Acid	C. A. Steifelmeyer, Hanceville, Ala	10.80	3.77	1.18	14.57
6[illegible]8	Dis. Bone	Graves & Burdin, Deposit, Ala	8.20	2.82	7.38	11.02
6366	B'ham H. G. Phosphate	S. A. Stewart, Hartselle, Ala	11.50	2.79	.66	14.29
6372	Read's Matchless Acid		9.25	5.10	2.00	14.35
6376	Cahaba H. G. Phosphate	S. F. Alston, Tuscaloosa, Ala	11.40	4.75	1.60	16.15
6381	Acid Phosphate	W. D. Hamilton, Guin, Ala	8.00	5.09	5.56	13.09

6384	Scott's H. G. Acid Phosphate	C. A. Steifelmeyer, Cullman, Ala	14.00	2.34	.36	16.34
6386	B'ham Acid Phosphate	" " " "	9.90	3.74	.76	13.64
6388	Atlas Acid Phosphate	" " " "	14.40	2.98	1.22	17.38
6392	Ga. State Standard Acid Phosphate	Law & Davis, Lincoln, Ala	3.55	9.79	2.26	13.54
6393	Scott's H. G. Phosphate	" " " "	9.10	6.24	2.16	15.34
6397	Teague's Acid Phosphate	S. F. Teague, Birmingham, Ala	9.30	6.14	3.16	15.44
6401	Scott's H. G. Acid	T. H. & A. B. Stephens, Seaborn, Ala	10.35	5.94	1.66	16.29
6404	B'ham H. G. Acid Phosphate	F. Ogden & Son, Sulligent, Ala	10.15	4.15	.70	14.30
6407	Ox H. G. Dis. Bone	Porter & Foster, Town Creek, Ala	13.65	3.82	1.48	17.47
6409	Ala. Acid Phosphate	J. B. Gray & W. W. Gulledge, Ohatchie, Ala	7.95	4.85	5.00	12.80
6426	H. G. Acid Phosphate	J. R. G. Howell, Dothan, Ala	5.05	8.89	1.76	13.94
6430	Dis. Bone Acid	Weathers, Swann & Co., Roanoke, Ala	8.10	5.29	.56	13.39
6433	Tuscaloosa Acid Phosphate	Tuscaloosa C. S. Oil Co., Tuscaloosa, Ala	13.95	3.93	.62	17.88
6435	H. G. Acid Phosphate	Hughes Bros., Florala, Ala	12.75	5.56	1.44	18.31
6440	Troy Acid Phosphate	Troy Fertilizer Co., Troy, Ala	9.85	4.50	2.50	14.35
6441	H. G. Acid Phosphate	" " " "	9.25	4.48	1.72	13.73
6442	English Acid Phosphate	" " " "	9.90	3.71	3.60	13.61
6443	English Dis. Bone Phosphate	" " " "	9.60	3.93	2.72	13.53

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6450	Excelsior Acid Phosphate	P. J. Ham & Son, Elba, Ala	13.40	3.47	.38	16.87
6451	Pomona	" " " "	1.75	3.47	.18	16.22
6457	Ga. State Grange Acid Phosphate	Hilton, Bently & Cosby, Brantley, Ala	10.10	4.05	1.30	14.15
6465	H. G. Acid Phosphate	J. T. Ramage, Brundidge, Ala	13.55	3.16	2.54	16.71
6466	" " "	" " " "	11.95	6.08	1.98	18.03
6467	" " "	" " " "	9.54	7.17	1.88	16.62
6471	Goulding's H G. Acid Phosphate	W. F. McKenzie, Greenville, Ala	14.85	3.42	.88	18.27
6474	J. C. Akin & Son's No. Acid Phosphate	J. C. Akin & Son, Notasulga, Ala	10.35	4.41	4.04	14.76
6477	H G. Acid Phosphate	First Bank of Elba, Elba, Ala	12.50	2.67	3.58	15.17
6486	" " "	W. E. Townsend, Elrath, Ala	.95	9.82	1.48	10.77

6494	H. G. Acid Phosphate	Burks & Coston, Brantley, Ala	8.55	4.51	4.84	13.06
6496	H. G. Dis. Bone	M. F. Patterson, Falkville, Ala	12.50	3.50	3.60	16.00
6501	Acid Phosphate	McMillan & Harrison, Mobile, Ala	14.20	3.65	0.20	17.85
6504	H. G. Acid Phosphate	W. S. Crass, Pelham, Ala	11.53	3.21	1.56	14.76
6506	" " "	Troy Fertilizer Co., Troy, Ala	15.30	1.76	1.94	17.06
6507	" " "	G. A. Sanders, Luverne, Ala	15.25	2.34	3.26	17.59
6511	" English Acid Phosphate	A. J. Pittman, Wehodkee, Ala	10.45	5.29	4.76	15.74
6515	H. G. Dis. Bone	W. A. Gage & Co., Town Creek, Ala	12.25	4.42	2.08	16.67
6519	Dis. Bone	Phillips Bros., Oxford, Ala	6.95	8.30	1.00	15.25
6523	Scott's H. G. Acid Phosphate	Ingram & Co., Anniston, Ala	12.10	4.61	1.04	16.17
6526	Eddystone Dis. Bone	J. Markentepe, Cullman, Ala	10.75	5.89	3.66	16.64
6529	H. G. Acid Phosphate	S. N. Power, Elba, Ala	13.00	4.07	1.58	17.07
6530	S. & Co's H. G. English Acid Phosphate	Schuessler & Co., Roanoke, Ala	9.45	4.91	5.74	14.36
6537	Pure H. G. Acid Phosphate	Britt & Johnson, Wetumpka, Ala	11.80	3.62	.58	15.42
6539	H. G. Acid Phosphate	McEntyre, Henderson & Adams, Ozark, Ala	13.00	3.81	3.84	16.81
6546	" " "	B. Bullard, Elba, Ala	9.35	7.27	.48	16.62
6549	Imperial Dis. Bone	George Kroell, Montevallo, Ala	11.35	3.88	.82	15.23
6551	H. G. Acid Phosphate	H. R. & H., Brantley, Ala	13.35	5.23	3.32	18.58

Analyses Reported by State Chemist from July 1st, 1900 to July 1st, 1901.

Acid Phosphates—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial value.
6558	B'ham H. G. Acid Phosphate	Geo. M. Truss & Co.. Springville, Ala	13.95	5.10	.20	$19 05
6562	Acid Phosphate	J. O. Hodges, Ashville, Ala	9.70	6.00	2.50	15.70
6564	Bear Dis. Bone	A. P. Howison, Randolph, Ala	13.00	5.76	2.84	18.76
6569	H. G. English Acid	M. W. Carlyle & Bro., Roanoke, Ala	6 90	6.15	6.80	13 05
6576	Matchless Acid Phosphate	Sessions & Mizell, Enterprise, Ala	7.90	4.19	3.76	12.09
6580	Birmingham Acid	T. A. Howle & Co., Oxford, Ala	6.75	7.08	.92	13.83
6585	Acid Phosphate	F. T. & J. C. Butler, Paint Rock, Ala	7.95	5.16	5.84	'3.11
6589	Imperial Acid	T. G. Land, Cullman, Ala	12.20	3.00	1.30	15.20
6589	Stern's H. G. Acid Phosphate	Chapman & Co., Geneva, Ala	12.70	6.10	1.70	18.80
6592	No. 1 Wet Phosphate	J. S. Collins, Geneva, Ala	3.50	6.99	4.56	10.49

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6593	No. 2 Wet Phosphate	J. S. Collins, Geneva, Ala	12.15	6.80	.90	18.95
6595	Crescent City Acid Phosphate	Crutcher & Ward, Cuba, Ala	12 60	4.09	2.76	16.60
6596	I. X. L. Acid Phosphate	" " "	12.80	5.51	2.04	18.81
6298	Read Phosphate	M. P. White, Attalla, Ala	9.00	5.68	.92	14.68
6600	Scott's H. G. Acid Phosphate	W. J. Silbert, Gadsden, Ala	12.35	3.82	.98	16.17
6602	I. X. L. Phosphate	Chas. Ivey, Evergreen, Ala	10.40	4.46	5.24	14.86
6604	H. G. Acid Phosphate	Zena Sheperd, Georgiana, Ala	11.10	5.22	2.28	16.32
6606	" " "	J. I. Covington, Bertha, Ala	8.70	5.82	.98	14.52
6612	Acid Phosphate	J. W. Grace. Elkmont, Ala	8.50	4.54	5.86	13.04
6614	Tenn. Valley Acid Phosphate	J. C. Hartselle & Son, Hartselle, Ala	6.65	4.26	6.44	10.91
6615	Florence Acid	" " " "	8.35	5.45	6.40	13.80
6618	" " Phosphate,	W. A. Shaw, Winfield, Ala	8.45	4.93	4.02	13.38
6620	Tuscaloosa Acid Phosphate	C. R. Maxwell, Northport, Ala	13.65	4.58	1.62	18.23
6623	Bear H. G. Dis. Bone	Bean & Murray, Heflin, Ala	6.95	8.13	1.42	15.18
6627	Sunny South Acid Phosphate	Elrod & Gibson, Collinsville, Ala	10.10	5.42	3.08	15.52
6629	Ox Acid Phosphate	Eranzen & Olson, Thorsby, Ala	9.60	6.49	2.86	16.00
6630	Ox H. G. Dis Bone	" " "	9.45	5.33	2.12	14.78
6632	Cahaba Acid Phosphate	T. U. Crumpton, Maplesville, Ala	9.80	3.01	.54	13.71

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphates.

Station Number.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6638	Acid	Asa Griffith, Hanceville, Ala	12.20	4.30	3.20	16.50
6639	Birmingham Acid	" " " "	10.30	3.30	1.05	13.60
6644	XXX Dis. Bone	G. W. Wise, Madison, Ala	7.35	5.65	3.25	13.00
6645	Sunny South	" " " "	9.25	5.35	3.55	14.60
6646	Meridian Southern Acid	G. H. Amos, Duck Spring, Ala	11.65	4.15	2.30	15.30
6652	Georgia State Grange Acid	F. D. Bynum, Bynum, Ala	8.75	9.70	1.45	13.45
6655	A. G. Winkler's H. G. Acid Phosphate	A. G. Winkler, Greenville, Ala	17.20	1.75	.25	18.95
6657	Talladega Acid Phosphate	John H. Wilson, Jenifer, Ala	13.30	3.20	.70	16.50
6660	Ox H. G. Dis. Bone	Hertzell & Anderson, Madison, Ala	11.10	7.90	.40	19.00
6661	Cahaba Acid Phosphate	John H. Wilson, Jenifer, Ala	13.20	8.85	.40	17.00

6663	English Acid Phosphate	W. W. Burnett, Geneva, Ala	12.00	4.45	2.00	16 45
6666	Port Royal Dis Bone	Lull & Lacey, Wetumpka, Ala	12.85	2.15	.70	14.50
6670	Acid Phosphate	Stewart & Hazelwood, Eden, Ala	5.40	5.77	.48	11.17
6671	Dis Bone	" " " " "	8.35	3.34	.86	11.79
6673	Georgia State Standard	D. D. Hughes, Lebanon, Ala	2 30	10.73	2 02	13.08
6675	Prolific Acid Phosphate	D. D. EcGowen, Cuba, Ala	14.50	4.40	.80	18.90
6476	Acid Phosphate	Cash Supply Co., Mountain Creek, Ala	11.60	2 07	1.08	13 67
6681	No. 1. Dis. Bone	Trawick & Jernigan, Opelika, Ala	9.50	4.86	3.84	14.36
6682	No. 2 Dis. Bone	" " " "	10.00	4.25	3.40	14.75
6690	I. X. L. Phosphate	W. D. Brown, Graville, Ala	11.85	4.05	2.50	15.90
6691	Goulding's H. G. Phosphate	" " " "	12.50	3.60	1.45	16.10
6692	Alabama Pure H. G. Phosphate	" " " "	11.10	4.65	1.95	15.75
6701	Alabama Phosphate	Green & Mullins, Active, Ala	10.55	5.20	2.55	15.75
6704	Tallapoosa Dis. Bone	White & Spigner, Goodwater, Ala	10.40	1.15	4.55	11.55
6711	Phosphate Excelsior Bone Compound	W. C. Perry, Seale, Ala	6.60	6.40	.70	13.00
6716	Eddystone Dis. Bone	W. H. Bynum, Boaz, Ala	8 25	7.85	2.25	16.10
6718	Alabama Acid Phosphate	J. H. Myers, Langston, Ala	14.05	2.80	.40	16.85
6721	No. 1 Acid Phosphate	J. C. Alford, Childersburg, Ala	9.55	8.20	1.05	17.75

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Acid Phosphates—Concluded.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial value.
6722	No. 2 Acid Phosphate	J. C. Alford, Childersburg, Ala	12.15	6.15	.95	$18.30
6729	Magnet Acid	Davis, Marshall & Co., Mobile, Ala	9.55	6.92	2.98	16.47
6732	Piedmont Acid Phosphate	R. F. Gilbert, Porterville, Ala	7.85	5.71	.54	13.66
6736	H. G. Acid Phosphate	Gunter & Elem, Gantt, Ala	13.45	3.65	2.80	17.10
6742	Cow Acid	McEntire Bros., Cullman, Ala	5.90	8.08	4.62	13.98
6743	Bull Acid	.. ..	7.10	4.87	7.88	11.97
6746	Acid Phosphate	S. W. Henry, Springville, Ala	8.15	5.42	3.98	13.57
6749	XXX Dis. Bone	R. Q. Edmolson & Bros., Eufaula, Ala	6.85	7.12	2.28	13.97
6755	Acid Phosphate	T. L. Johnson & Co., Gadsden, Ala	9.65	5.48	1.82	15.18
6756	J. C. Adkin & Son's No. 1 Acid Phosphate	Opelika Chemical Co., Opelika, Ala	10.80	5.61	2.54	16.41

6757	Griel Bros. English Acid Phosphate	Opelika Chemical Co., Opelika, Ala	10.70	6.59	1.86	17.29
6758	Standard Acid Phosphate	.. ..	11.80	6.00	2.00	17.80
6759	H. G. English Acid Phosphate	.. ..	10.90	6.48	2.02	17.38
6760	S. & Co's H. G. English Acid	.. ..	10.75	6.39	2.46	17.14
6761	H. & T. H. G. Acid Phosphate	.. ..	10.65	6.63	2.52	17.28
6780	H. G. Acid Phosphate	Montgomery Fertilizer Co., Montgomery, Ala.	11.05	5.69	2.26	16.74
6781	Vandiver's XX Acid Phosphate	.. ..	10.25	6.13	2.82	16.38
6782	S. & O. H. G. Acid Phosphate	.. ..	11.05	5.95	2.80	17.00
6783	Thompson's English Acid Phosphate	.. ..	10.95	6.26	1.84	17.21
6784	Star Brand Acid Phosphate	.. ..	10.85	5.76	2.54	16.61
6785	Early Bird H. G. Acid Phosphate	.. ..	10.40	7.25	1.80	17.65
6786	S. & K. English Acid Phosphate	.. ..	11.05	6.81	1.84	17.86
6787	W. L. & Co's H. G. Acid Phosphate	.. ..	11.20	6.18	2.12	17.38
6803	H. G. English Acid Phosphate	.. ..	11.65	4.73	2.42	16.38
6808	H. G. Acid Phosphate	W. B. Willhite, Hartselle, Ala	8.80	6.28	2.52	15.08
6811	Dixie Acid Phosphate	C. W. Bell & Son, Lineville, Ala	10.90	4.87	4.58	15.77
6812	H. G. Dis. Bone	.. ..	5.70	7.45	5.80	18.15
6815	H. G. Acid Phosphate	G. W. Roberts & Co., Collinsville, Ala	4.80	7.49	1.86	12.29

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Acid Phosphate.

Station Number.	Name of Sample.	By Whom Sent	Phosphoric Acid.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6821	Marietta H. G. Acid	Reeves, Sanders & Co, Heflin, Ala	11.70	5.14	.26	16.64
6824	Sunny South Acid Phosphate	W. B. Vaughn, Elkmomit, Ala	9.00	6.09	6 56	15.09
6827	H. G. Acid Phosphate	F. A. Gulledge, Verbena, Ala	13.95	5.13	0.42	19.08
6828	Ox Dis. Bone	.. ..	10.75	5.17	2.68	15 92
6830	Coweta H. G. Acid	White & Aubrey, Roanoke, Ala	6.90	4.69	3.26	11.59
6838	Sunny South Phosphate	A. B. Vandigraft & Son, Birmingham, Ala	10.50	5.12	2.98	15.62
6842	English Acid Phosphate	E. H. & A. S. Murdock, Coffee Springs, Ala	10.70	6.32	1.38	17.02
6444	Standard Acid Phosphate	Cameron Bros., Notasulga, Ala	9.25	5.79	3.46	15.04
6846	Bear H. G. Dis. Bone	T. L. Neighbors & Bros, Goodwater, Ala	10.50	4.78	3.02	15.28
6852	Birmingham H. G. Acid Phosphate	W. J. Mullins, Clanton, Ala	11.40	4.35	.75	15.75

6856	Marietta H. G. Dis. Bone Acid	West & McMurry, Roanoke, Ala	6.65	4.77	.78	11.42
6858	Eddystone Dis. Bone	Montgomery Bros., Lincoln, Ala	10.45	4.79	2.86	15.24
6861	Adair's H. G Dis. Bone	John T. Tabor, Keener, Ala	10.25	2.10	3.80	12.85
6864	Scott's Acid	Haley Bros., Haleyville, Ala	12.35	4.04	1.06	16.89
6865	Florence Acid	.. ..	8.85	5.60	4.80	14.45
6866	Bear Acid	.. ..	10.15	5.74	3.16	15.89
6871	Howle Bros. Acid Phosphate	Howle Bros., Wetumpka, Ala	11.35	6.48	.52	17.83
6873	Phosphate No. 3	Ozark C. S. Oil Mill and Fert. Co., Ozark, Ala	8.20	7.15	1.40	15.35
6875	Black Diamond Acid	E. P. Duncan, Alexander City, Ala	7.30	7.06	2.54	14.36
6881	Tiger Acid	The J, H. Karter Co., Cullman, Ala	7.90	6.10	6.20	14.00
6884	English Acid Phosphate	T. H. NcEntyre, Coffee Springs, Ala	9.00	5.77	3.08	14.77
6886	Eagle Acid Phosphate	L. O. Cox, Boaz, Ala	5.45	8.01	3.84	13.46
6887	Eagle Dis. Bones.	.. ..	6.00	8.14	2.16	14.14
6895	Sunny South Acid	M. Noble, Avery, Ala	9.35	4.54	3.46	13.89
6397	Phosphate	Rintz Turner, Thomasville, Ala	9.65	4.03	1.22	13.68
6899	Acid Phosphate	T. B. Williams, Cullman, Ala	9.70	5.62	3.48	15.32
6904	Eagle Acid Phosphate	S. J. Baird, Guin, Ala	10.55	5.94	5.06	16.49
6905	Tallapoosa H. G. Acid Phosphate	Tallapoosa Oil Co, Alexander City, Ala	9.90	5.35	.70	15.25

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Acid Phosphate.

Station Number.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Commercial Value.
6220	Cahaba H. G. Acid Phosphate	Birmingham Fertilizer Co., Birmingham, Ala.	12.73	3.79	.20	16.52
6220	Earle Terrell & Co's. H. G. Acid Phos.	.. ..	12.73	3.79	.20	16.52
6221	Cahaba Standard Grade Phosphate	.. ..	11 33	3.62	.23	14.95
6220	Prolific Acid Phosphate..	.. ..	12.73	3.79	.20	16.52

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Miscellaneous Fertilizers and Fertilizing Materials.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Phosphoric Acid. Total.	Nitrogen.	Potash.
6214	Cotton Seed Meal	Tucker & Willingham, LaFayette, Ala	....	....	2.79	7.14	2.06
6215	" " " Off	" " " "	....	....	2.77	6.18	1.62
6216	" " "	Mutual Cotton Oil Co., Columbus, Ga	....	....	....	7.20	....
6217	" " "	Dothan " " " Dothan, Ala	....	....	2.80	7.32	1.89
6218	" " " Off	" " " " " "	....	....	2.88	6.42	1.87
6219	" " "	LaFayette Cotton Oil Co., LaFayette, Ala.	....	....	2.86	6.42	2.01
6255	" " " No. 1	Dadeville Oil Mill, Dadeville, Ala	....	....	2.67	7.11	1.95
6256	" " " No. 2 Off	" " " " "	....	....	2.61	6.86	1.99
6260	" " "	Walter Andrews, LaFayette, "	....	....	2.65	6.84	2.04
6261	" " " Off	" " " "	....	....	2.90	6.93	1.94

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

Miscellaneous Fertilizers and Fertilizing Materials.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Phosphoric Acid. Total.	Nitrogen.	Potash.
6283	Cotton Seed Meal No. 2	Greenville Cotton Oil Mill, Greenville, Ala	......	.....	2.93	6.96	2.0?
6284	" " " 3 Off	" " "	......	....	3.10	6 42	1.90
6286	" " " "A"	D. E. Huger & Co , Mobile, Ala	....	....	3.61	6.54	1.92
6287	" " " "Z"	" " " "	....	.....	3.48	6.54	1.79
6308	" " "	J. T. Scott, Buffalo, Ala	....	....	3.10	6.54	1.81
6359	" " "	Jefferson Cotton Oil Mill, B'ham, Ala.	......	.....	2.42	7.52	1.88
6360	" " "	Sylacauga Oil Mill, Sylacauga, "	......	....	2.87	7.08	1.72
6361	" " "	Richmond Cotton Oil Mill, Sheffield, Ala.	......	.....	2 67	6.66	1.72
6362	" " "	B. Schmidt & Son, Lincoln, Ala	....	.....	2 97	7.08	1.58
6363	" " "	T. G. Connor, Tuskegee, "	......	.....	3.02	6.90	1.62

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6364	Cotton Seed Meal	C. C. Woodard, Fruitdale, Ala	......	......	3.75	7.08	1.76
6365	.. .. ..	Evergreen M'f'g Co., Evergreen, Ala	......	......	2.90	6.84	1.64
6414	.. .. ..	Jackson & Chapman, Grand Bay, ..	......	......	3.56	6.84	2.15
6488	.. .. .. Off	C. C. Woodard, Fruitdale, ..	......	......	3.82	7.02	2.32
6489	.. .. .. Bright	.. .. ..	......	......	3.25	6.96	1.91
6662	.. .. ..	Leder Oil Mills, Demopolis, ..	......	......	3.18	6.84	1.84
7048	.. .. ..	.. ..	......	......	3.80	6.96	1.60
6202	Bat Manure & Cave Earth	L. H. Scruggs, Huntsville, ..	......	......	9.35	2.84	1.51
6208	Coarse Horse Manure	J. F. Duggar, Auburn, ..	......	......	.52	1.27	1.30
6208	Fine Horse Manure	.. .. ..	......	......	.67	.87	1.00
6205	Fertilizer No. 7	Helm Milling Co., Birmingham, ..	......	......	......	....	2.62
6207	Muriate of Potash	Ozark C. S. Oil Mill & Fert. Co., Ozark	......	......	......	......	56.15
6213	Tankage	B'ham Hide & Tallow Co., B'ham, Ala	......	......	10.13	6.04	......
6226	Fertilizer No. 1748	Mississippi Station, Starksville, Ala	......	......	......	.....	2.75
6251	German Kainit	Troy Fertilizer Co., Troy, Ala	......	......	......	......	13.40
6258	Kainit	Trawick & Jernigan, Opelika, Ala	......	......	......	......	14.12
6281	Ashes	C. C. Woodard, Fruitdale, ..	......	......	1.85	......	1.28
6288	Soil	F. Y. Anderson, Birmingham, ..	......	......	.20	.07	.05

Analyses Reported by the State Chemist from July 1, 1900 to July 1, 1901.

Miscellaneous Fertilizers and Fertilizing Materials—Concluded.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Phosphoric Acid. Total.	Nitrogen.	Potash.
6289	Soil	Prattville Mercantile Co., Prattville, Ala.	......	......	.26	.03	.06
6309	Muriate	C. C. Woodard, Fruitdale, Ala	......	......	......	......	51 90
6439	Phosphate Rock	J. C. Adams, Montgomery, Ala	......	......	.45	......	......
6464	Cotton Seed Meal Ash	Huntsville Nursery Co., Huntsville, Ala.	15.68	.60	16.28	......	1.20
6500	German Kainit	McMillan & Harrison, Mobile, Ala	......	......	......	....	12.64
6566	No. 1 Phos-Rock	J. A. Alexander, Prattville, Ala	......	......	1.45	......	......
6567	No. 2 " "	" " " "	......	......	.40	......	......
6568	No. 3 " "	" " " "	......	......	.45	......	......
6586	Kainit	F. T. & J. C. Butler, Paint Rock, Ala	......	......	......	.....	10.74
6636	Marl	J. F. Jones, Evergreen, Ala	......	....	.23	......	.....

6659	Kainit	J. H. Wilson, Jenifer, Ala.					18.14
6781	German Kainit	Davis, Marshall & Co., Mobile, Ala.					14.14
6849	Phosphate Rock	H. S. Houghton, Blount Springs, Ala.			.82		
6850	.. ..	Prim & Kimbel, Jackson, Ala.			.22		
7049	.. ..	C. F. Austin, Auburn, Ala.			.72		
7050	.. ..	A. U. Grouby, Abbeville, Ala.			.84		
6211	Pure Tobacco Stems	Helm Milling Co., Birmingham, Ala.					9.18
6212	Mixture Tobacco Stems and Filler	.. ..					2.48

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Miscellaneous Samples from the Commissioner.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial value.
6914	No. 806	Commissioner of Agriculture, Montgomery, Ala.	12.70	3.79	.76	.....	2.40	$18.89
6915	" 807	" " " " "	7.40	3.22	3.78	.....	2.59	18.21
6916	" 808	" " " " "	11.95	5.59	.66	......	......	17.54
6917	" 809	" " " " "	7.95	5.78	4.32	1.28	2.29	18.60
691[illegible]	" 810	" " " " "	11.95	3.10	1.06	......	2.69	17.88
6919	" 811	" " " " "	6.35	3.15	2.50	1.60	2.59	16.57
6920	" 812	" " " " "	11.85	5.07	.88	.....	2.58	19.50
6921	" 813	" " " " "	11.55	5.10	.80	......	2.40	19.05
6922	" 814	" " " " "	7.35	2.68	3.54	1.60	2.10	16.55
6923	" 815	" " " " "	11.20	6.20	.80	......	2.05	19.45

6924	No. 816	..	..	..	..	..	7.30	3.78	.12	1.94	2 20	18.71
6925	" 817	..	..	..	..	..	6.60	3.67	4.08	1.82	2.29	17.66
6926	" 818	..	..	..	..	..	6.40	4.20	7.70	1.98	2.18	18.27
6027	" 819	..	..	..	..	..	13.05	3.39	.96	......	....	16.44
6928	" 820	..	..	..	..	..	6.50	4.54	2.46	1.00	2.45	16.29
6929	" 821	..	..	..	..	..	7.70	6.21	5.84	......	......	18 91
6930	" 822	..	..	..	..	..	7.60	3.53	2.62	1.82	1.80	18.08
6931	" 823	..	..	..	..	..	7.70	5.60	1.90	1.64	1.60	18.49
6932	" 824	..	..	..	..	..	9.35	3.55	6.20	......	1.41	14.31
6933	" 825	..	..	..	..	..	6.35	3.04	5.96	2.14	1.67	17.05
6934	" 826	..	..	..	..	..	7.75	2.94	1.26	......	2.40	13.09
6935	" 827	..	..	..	..	..	10.75	2.59	3.36	1.42	2.49	19.81
6936	" 828	..	..	..	..	..	8.70	2.56	.94	1.96	2.31	19.06
6937	" 829	..	..	..	..	..	8.70	2.23	1.52	1.30	2.67	17.24
6938	" 830	..	..	..	..	..	8.35	5.44	.96	......	......	18.79
6939	" 831	..	..	..	..	..	10.25	4.08	.72	.28	2.38	19.49
6940	" 832	..	..	..	..	..	7.00	3.84	3.26	1.72	2.40	17.56
6941	" 833	..	..	..	..	..	8.40	4.23	1.42	1.72	2.05	19.50

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

Miscellaneous Samples from the Commissioner—Continued.

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Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6942	No. 834	Commissioner of Agriculture, Montgomery, Ala	8.70	6.68	2.12	.18	2 57	$18.45
6943	.. 835	.. ..	9.55	3.19	1.66	1.88	2.56	20.56
6944	.. 836	.. ..	6.95	5.32	8.53	.50	1.82	14.99
6945	.. 837	.. ..	7.95	6 81	7.84	.....	......	14.76
6946	.. 838	.. ..	7.95	5.50	2.10	1.72	1.48	19.70
6947	.. 839	.. ..	11.30	6.05	2.20	......	.....	17.85
6948	.. 840	.. ..	8.40	4 58	3.82	.98	1.66	17.38
6949	.. 841	.. ..	4.55	4.40	1.00	.....	......	13.95
6950	.. 842	.. ..	8.60	3.48	2.12	1.88	2.10	19.44
6951	.. 843	.. ..	......	.....	......	.....	18.60	18.60

6952	.. 844	..	..	..	..	9.15	8.61	2.84	1.06	2.24	17.97
6953	.. 845	..	..	..	..	12.60	8 50	2.40	......	......	16.10
6954	.. 846	..	..	..	..	6.85	4.15	8.50	1.96	1.54	18.08
6955	.. 847	..	..	..	..	11.70	2 98	1.72	....	......	14.68
6956	.. 848	..	..	..	..	9.00	1.81	1.84	1.76	1.89	17.18
6957	.. 849	..	..	..	..	7.85	8.48	.82	.12	2.22	18.84
6958	.. 850	..	..	..	..	7.20	4.49	4.06	1.88	2.41	19.86
6959	.. 851	..	..	..	..	7.45	8.80	6.65	1.36	1.80	16.86
6960	.. 852	..	..	..	..	6.70	2.98	6.82	1.88	1.49	16.43
6961	.. 853	..	..	..	..	11.65	5.56	1.84	......	.....	17.21
6962	.. 854	..	..	..	..	6.25	4.57	2.26	1.92	2.59	18.79
6963	.. 855	..	..	..	.	7.20	8.92	.78	2.88	2.44	20.22
6964	.. 856	..	..	..	..	5.45	6.62	2.28	......	......	12.07
6965	.. 857	..	..	..	..	10.40	4.44	8.66	......	......	14.84
6966	.. 858	..	..	..	..	7.50	4.40	5.40	2.18	1.48	19.48
6967	.. 859	..	..	..	..	6.65	8.12	2.68	1.70	2.89	16.92
6968	.. 860	..	..	..	..	5.05	10.42	1.68	......	......	15.47
6969	.. 861	..	..	..	..	5.50	4.89	6.66	1.88	2.68	18 28

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

Miscellaneous Samples from the Commissioner.

Station Number.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6970	No. 862	Commissioner of Agriculture, Montgomery, Ala.	9.80	7.37	4.38	....	......	17.17
6971	" 863	" " " " "	11.20	5.06	.84	....	.	16.20
6972	" 864	" " " " "	8.65	4.65	2.30	2.04	3.88	20.84
6973	" 865	" " " " "	......	......	......	.....	12.28	12.28
6974	" 866	" " " " "	12.40	6.54	2.26	.....	...	18.94
6975	" 867	" " " " "	4.90	6.06	6.94	1.86	2.31	18.48
6976	" 868	" " " " "	12.65	3.93	.92	...	.52	17.10
6977	" 869	" " " " "	13.15	3.87	1.08	......	.....	17.02
6978	" 870	" " " " "	13.00	5.20	1.00	....	......	18.20
6979	" 871	" " " " "	8.10	4.85	3.20	.82	2.28	17.53

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6980	No. 872	..	..	..	..	..	1.65	12.79	2.06	.....	.....	14.44
6981	.. 873	..	..	..	..	..	7.45	8.02	1.88	....	.....	15.47
6982	.. 874	..	..	..	..	..	6.80	8.25	2.40	1.72	2.75	17.62
6983	.. 875	..	..	..	..	..	7.25	8.96	2.94	2.80	2.14	19.79
6984	.. 876	..	..	..	..	..	6.10	8.49	2.66	1.84	1.91	16.65
6985	.. 877	..	..	..	..	..	5.44	12.84	.62	.....	.	17.78
6986	.. 878	..	..	..	..	..	7.75	8.47	5.88	1.72	1.64	17.7[illegible]
6987	.. 879	..	..	..	..	..	8.45	5.11	4.84	1.04	1.81	17.7[illegible]
6988	.. 880	..	..	..	..	..	9.10	5.59	8.56	.68	1.67	18.25
6989	.. 881	..	..	..	..	..	5.12	10.19	.54	.02	1.42	16.79
6990	.. 882	..	..	..	..	..	10.85	8.28	.52	.04	1.19	15.48
6991	.. 883	..	..	..	..	..	5.25	8.71	.44	1.20	8.00	15.82
6992	.. 884	..	..	..	..	..	6.90	2.90	.95	.....	2.18	11.98
6993	.. 885	..	..	..	..	..	10.90	4.69	1.54	.....	.....	15.59
6994	.. 886	..	..	..	..	..	7.05	6.35	2.10	.16	2.41	16.28
6995	.. 887	..	..	..	..	..	8.85	2.95	2.20	.....	.....	12.80
6996	.. 888	..	..	..	..	..	8.05	2.09	1.86	.....	....	10.14
6997	.. 889	..	..	..	..	..	9.70	.85	6.70	2.02	1.69	17.40

Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

MISCELLANEOUS SAMPLES FROM THE COMMISSIONER—Continued.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value.
6998	No. 890	Commissioner of Agriculture, Montgomery, Ala	7.10	5.00	4.00	1.78	1.34	$18.42
6999	.. 891	.. ..	5.80	4.88	1.22	2.82	2.27	19.45
7000	.. 892	.. ..	6 00	6.54	1.96	1.24	1.54	17.55
7001	.. 893	.. ..	7.35	3.04	3.26	1.66	2.29	17.8[illegible]
7002	.. 894	.. ..	4.55	9.37	.98	3.54	2.41	25.24
7003	.. 895	.. ..	2.65	8.14	.86	1.92	2.56	18.78
7004	.. 896	.. ..	2.20	9.38	.62	2.04	1.91	19.20
7005	.. 897	.. ..	2.30	9.66	1.84	2.40	2.64	21.32
7006	.. 898	.. ..	8.55	3.66	3.26	1.24	2.28	17.99
7007	.. 899	.. ..	9.95	1.35	9.90	.....	.....	11.30

7008	.. 900	....	..	..	..	..	8.95	2.65	2.80	1.28	1.04	16.28
7009	.. 901	....	..	..	..	..	8.20	8.39	1.96	.....	2.24	18.88
7010	.. 902	....	..	..	..	..	11.60	5.11	1.54	.12	.18	17.18
7011	.. 903	....	..	..	..	..	11.25	6.01	8.04	08	.10	17.58
7012	.. 904	....	..	..	..	..	5.00	4.97	1.98	......	2.77	12.74
7013	.. 905	....	..	..	..	..	7.90	4.87	6.48	.10	2.91	15.86
7014	.. 906	....	..	..	..	..	6.80	3.51	1.04	2.08	1 51	17 61
7015	.. 907	....	..	..	..	..	7.70	3.52	.88	1.96	2.51	19.2.
7016	.. 908	....	..	..	..	..	5.10	3.81	2.04	1.98	2.72	17.17
7017	.. 909	....	..	..	..	..	12 70	3.28	4.82	.....	......	15.98
7018	.. 910	....	..	..	..	..	7.40	2.06	3.64	2 04	2.09	17.26
7019	.. 911	....	..	..	..	..	7.75	5.49	1.86	1.02	1.28	17.18
7020	.. 912	....	..	..	..	..	8.30	7.43	2.92	..	2.00	17.73
7021	.. 913	....	..	..	..	..	6.85	5.67	4 28	.	......	12.52
7022	.. 914	....	..	..	..	..	8.00	2.12	3.96	1.88	2 18	16.16
7023	.. 915	....	..	..	..	.	7.95	4 21	2.64	1.34	1.22	17.13
7024	.. 916	....	..	..	..	..	9.25	5.63	2.92	......	......	14.88
7025	.. 917	....	..	..	..	..	9.00	3.44	1.96	1.56	1.57	18.88

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Analses Reported by State Chemist from July 1, 1900 to July 1, 1901.

Miscellaneous Samples from the Commissioner—Concluded.

Station No.	Name of Sample.	By Whom Sent.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Nitrogen.	Potash.	Commercial Value
7026	No. 918	Commissioner of Agriculture, Montgomery, Ala.	9.15	.50	1.90	1.48	2.73	16.52
7027	.. 919	.. .. ..	7.60	3.11	2.74	2.02	2.00	18.37
7028	.. 920	.. .. ..	8.06	3.74	.66	......	3.22	15.56
7029	.. 921	.. .. ..	9.20	1.54	1 36	1.70	2.77	18.27
7030	.. 922	.. .. ..	9.25	4.02	1.58	1.62	1.36	19.17
7031	.. 923	.. .. ..	10.35	5 64	5.86	......	......	15.99
7032	.. 924	.. .. ..	7.20	8.07	2.08	..	1.80	17.07
7033	.. 925	.. .. ..	6.40	3.72	2.78	1.60	1.58	16.55
7034	.. 926	.. .. ..	6.35	2.15	2.60	1.34	2.24	14.49
7035	.. 927	.. ..	7.90	5.17	1.68	.96	.87	16.63

7036	.. 928	..	..	..	9.85	2.70	1.40	1.64	2.06	18.70
7037	.. 929	..	..	..	18.50	2.18	1.72	......	......	15.68
7038	.. 930	..	..	..	6.25	6.83	1.82	......	......	12.58
7039	.. 931	..	..	..	6.85	5.96	6.04	......	2.28	15.09
7040	.. 932	..	..	..	6.00	6.09	7.46	1.40	1.49	17.50
7041	.. 933	..	..	..	5.85	3.81	4.54	1.60	2.82	16.46
7042	.. 934	..	..	..	6.45	4.46	4.04	1.58	1.49	16.82
7043	.. 935	..	..	..	8.15	2.64	1.76	2.02	1.87	18.32
7044	.. 936	..	..	..	8.15	3.89	2.76	1.46	1.76	17.89
7045	.. 937	..	..	..	18.40	5.34	1.06	......	......	18.74
7046	.. 938	..	..	..	8.50	5.34	2.66	1.10	1.12	18.04
7047	.. 939	..	..	..	7.60	2.90	3.20	2.20	2.11	18.77

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value
			Nitrogen.	Phosphoric Acid			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Mobile Acid Phosphate & Potash, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	8–10	2–4	2–3	1–2	$ 11 16
..	Mobile Dissolved Bone and Potash, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	8–10	2–4	2–3	2–3	12 17
..	Mobile Alkali Bone Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	6–8	2–4	2–3	4–5	12 17
..	Mobile Ammoniated Fertilizer, manufactured by Mobile-Phosphate Company, Mobile, Ala	200	2.08–3	7–9	2–4	15–2	1–2	15 77–
..	Genuine German Kainit, manufactured by Mobile Phosphate Company, Mobile, Ala	200	......	...	.....	.....	12–13	23 40 12 13
..	Mobile 446 Special Truck, manufactured by Mobile Phosphate Company, Mobile, Ala	200	3.30–4.50	3–4	1–2	1–2	4–8	19 24–
..	Mobile H. G. Truck Fertilizer, manufactured by Mobile Phosphate Company, Mobile, Ala	200	6.60–8	4–5	2–3	1–2	4–6	26 60 28 48–
..	I. X. L. Acid Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	10–12	2–3	2–3	.....	36 40 12 14
..	English Acid Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	12–13	2–3	2–3	.....	14 16
..	Mobile Standard Guano, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.05	6–7	2–3	1.50–2	2–3	20 00 14 62–

Oct. 1	KKK Ammoniated Soluble Bone, manufactured by Mobile Phosphate Company, Mobile, Ala	200	85–1.25	8–10	2–8	1.50–2	1–2	13 88–18 50
..	Eclipse Soluble Guano, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.05	7–8	2–8	1.50–2	1–2	14 62–20 00
..	Mobile Soluble Bone and Potash, manufactured by Mobile Phosphate Company, Mobile, Ala	200	....	8–10	2–3	2–8	8–4	18 00–17 00
..	Mobile Double Eagle Guano, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.50	7.50–8.50	2.50–8 50	1.50–2	2–8	15 62–21 00
..	Rhodes Blood and Bone, manufactured by Mobile, Phosphate Company, Mobile, Ala	200	1.65–2.50	6–7	2–8	1.50–2	2–8	14 62–20 00
..	Mobile Blood Bone and Potash Compound, manufactured by Mobile Phosphate Company, Mobile, Ala	200	1.65–2.50	6–7	2–8	1.50–2	2–8	14 60–20 00
..	Patapsco Guano Co's XX Acid Phos and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	......	8	2	2	4	14 00
..	Acid Phos and 4% Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	......	5	8	2	4	12 00
..	Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	8	2	2	2	12 00
..	Acid Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga	200	......	10	2	2	1	13 00
..	Dissolved Bone Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	11	2	2	.....	13 00
..	Mastodon Ammo. Soluble Phos., manufactured by Georgia Chemical Works, Augusta, Ga	200	1.65	7	8	2	2	16 62
..	Georgia Formula, manufactured by Georgia Chemical Works, Augusta, Ga	200	1.65	7	1	1	2	14 62
..	Mascot Soluble Bone, manufactured by Georgia Chemical Works, Augusta, Ga	200	.82	8	2	2	1	13 30
..	XX Acid Phosphate with Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	......	8	2	2	4	14 00
..	Acid Phosphate with 4% Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	5	8	2	4	12 00
..	Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	8	2	2	2	12 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Citrate Soluble	Acid Soluble	Potash.	Relative Commercial Value
1900 Oct. 1	Acid Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	10	2	2	1	$13 00
..	Dissolved Bone Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	11	2	2	....	13 00
..	Muriate of Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	.....	....	...	48	48 00
..	Genuine German Kainit, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....		......	..	12	12 00
..	Patapsco Guano Company's Patapsco Guano, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	3	2	2	16 62
..	Ammoniated Dissolved Bone, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	1	1	2	14 62
..	Baltimore Soluble Bone, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.82	9	2	2	1	13 30
..	Muriate of Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	....	......	.....	....	48	48 00
..	Genuine German Kainit, manufactured by Georgia Chemical Works. Augusta, Ga.	200	....	....	.....	...	12	12 00
..	Pon Pon Crop Grower—Patapsco Guano Co's, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.00	7	3	1	2	14 80

Sea Gull Guano, manufactured by Georgia Chemical Works, Augusta, Ga	200	1.00	7	8	1	2	14 80
Md. Am. Diss. Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	1.65	6	8	1	1	14 62
12% Dissolved Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga	200	....	10	2	1.50	.....	12 00
High Grade Blood and Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	7	....	8	8	.....	22 60
Special, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	7.50	.....	2 50	2.50	.....	28 50
Fine Ground Beef Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	2.50	....	12.50	12.50	.....	19 50
Pure Raw Bone Meal, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	4	.....	6	7	....	17 20
Acidulated Animal Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	2	......	12 50	4.50	8	22 60
Ammoniated Bone and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kas	200	2.50	8	4	8	1	15 00
Blood, Bone and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	4	6	8	2	7	27 20
Fertilizer No. 583, manufactured by Armour Fertilizer Works, Kansas City, Kas	16[illegible]	4	5	8	2.50	8	22 20
Fertilizer No. 386, manufactured by [illegible] Fertilizer Works, Kansas City, Kas	16[illegible]	2.50	5	8	2	6	21 00
Fertilizer No. [illegible] manufactured by A[illegible] Fertilizer Works, Kansas City, [illegible]	16[illegible]	1.50	5.50	2.50	1.50	5	17 62
Fertilizer No. [illegible] manufactured by Armour Fertilizer Works, Kansas City, Kas	16[illegible]	1.50	5.50	2.50	1.50	2	14 62
Fertilizer No. 281, manufactured by [illegible] Fertilizer Works, Kansas City, Kas	167	1.50	5 50	2.50	1.50	1	18 62
Fertilizer No. 272, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	1.50	5	2	1.50	2	18 [illegible]
Fertilizer No. 271, manufactured by Armour Fertilizer Works, Kansas City, Kas	167	1.50	5	2	1.50	1	18 62

Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analyses: Nitrogen.	Phosphoric Acid: Water Soluble.	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble.	Potash.	Relative Commercial Value
1900 Oct. 1	African Cotton Grower, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	2.50	5	4	1	3	$ 19 00
..	Potato Fertilizer, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	3.50	3.50	2.50	1	4	19 40
..	Fertilizer No. 721, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	4	3	1.50	1	12 20
..	Fertilizer No. 722, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	4	3	1.50	2	13 20
..	Fertilizer No. 821, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	4	3	1.50	1	13.20
..	Fertilizer No. 822, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	5	3	1.50	2	14 20
..	Ammo D. B. and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	1.50	6.50	3.50	2	2	16 20
..	Acid and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kansas	167	......	7	3	1.50	2	12 00
..	Acid and Potash manufactured by Armour Firtilizer Works, Kansas City, Kansas	467	......	6	2	1	4	12 00
..	Acid Phosphate, manufactured by Armour Fertilizer Works, Kansas City, Kansas	200	......	8	4	2	......	12 00

..	Old Plantation Guano, manufactured by Union Fertilizer Co., Atlanta, Ga.	167	1.64.7	6	2	2	2	14 61
..	Union Cotton Grower, manufactured by Union Fertilizer Co., Atlanta, Ga	200	1.64.7	6	2	2	2	14 61
..	Dixie Guano, manufactured by Union Fertilizer Company, Atlanta, Ga.	200	1 64.7	6	2	2	2	14 61
..	Animal Bone and Peruvian Compound, manufactured by Union Fertilizer Co., Atlanta. Ga	200	82.4	7	8	2	1	18 81
..	Merrimac Guano, manufactured by Union Fertilizer Co , Atlanta, Ga	200	1.61.7	6	2	2	2	14 61
..	Blood, Bone and Potash, manufactured by Union Fertilizer Co., Atlanta, Ga	200	82.4	7	8	2	1	18 81
..	Free Silver 16 to 1 Compound, manufactured by Union Fertilizer Co., Atlanta, Ga	200	82.4	7	8	2	1	18 81
..	U. C. Dis. Bone, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	7	8	2	2	12 00
..	Union Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta. Ga	200	....	7	8	2	2	12 00
..	Dixie Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	7	8	2	2	12 00
..	Merrimac Potash Acid Phosphate, manufactured by Union Fertilizer Co , Atlanta, Ga	200	....	7	8	2	2	12 00
..	Union Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta. Ga	200	....	9	8	2	......	12 00
..	Dixie Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	9	8	2	......	12 00
..	Merrimac Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	9	8	2	....	12 00
..	Bone and Potash Mixture, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	6	2	2	4	12 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Union High Grade Acid Phosphate and Potash, manufactured by Union Fertilizer Co., Atlanta, Ga	200	....	6	2	2	2	$10 00
..	Taylor's Anti-Sharp-Shooter, manufactured by Union Fertilizer Co., Atlanta, Ga	200	82.4	7	3	2	1	13 81
..	Star Brand, manufactured by Union Fertilizer Company, Atlanta, Ga	[illegible]	82.4	7	3	2	1	13 31
..	U. C. Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga	[illegible]	...	6	2	2	4	12 00
..	Read's Soil Food, manufactured by Read Phosphate Co., Nashville, Tenn	[illegible]	1.647–2.47	6–8	2–3	1–2	2–3	14 61
..	Farmer's Special Manure, manufactured by Read Phosphate Co., Nashville, Tenn	200	82–1 64	8–10	2–3	1–2	3–4	15 30
..	Read's Cotton Flower, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	3–4	1–2	3–4	16 60
..	Wynn's Pacific Guano, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	2–3	1–2	1–2	13 60
..	Read's Blood and Bone, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	2–3	1–2	1–2	13 60
..	Read's Matchless Cotton Grower, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647–2.47	6–8	2–3	1–2	1–2	13 61

..	Read's Farmers' Friend Fertilizer, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647-2.47	6-8	8-4	1-2	1-2	14 61
..	Read's Blood, Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn	200	.82-1.647	6-8	2-3	1-2	1-2	18 80
..	Read's Blood and Bone and No. 1, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647-2.47	6-8	2-3	1-2	2-3	14 61
..	Read's Blood and Bone Special, manufactured by Read Phosphate Co., Nashville, Tenn	200	.82-1.647	7-10	3-4	1-2	1-2	18 80
..	Read's Alkaline Bone, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	8-10	2-3	1-2	2-3	12 00
..	Read's Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	8-10	2-3	1-2	2-3	12 00
..	Read's Special Potash Mixture, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	8-10	2-3	1-2	4-6	14 00
..	Read's Acid Phosphate and Pot., manufactured by Read Phosphate Co., Nashville, Tenn	200	.....	6-8	2-3	1-2	4-6	12 00
..	Read's Matchless Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	10-12	2-3	2-3	...	12 00
..	Read's XXX Dissolved Bone, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	10-12	3-4	2-3	....	13 00
..	Read's High Grade Acid Phosphate, manufactured by Read Phosphate Co, Nashville, Tenn	200	....	10-12	4-5	2-3	.....	14 00
..	Read's H. G. Amo. Dissolved Bone, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.647-2.47	8-10	2-3	1-2	2-3	16 61
..	Satin Staple Guano, manufactured by Read Phosphate Co., Nashville, Tenn	200	2.05-3.07	6-8	4-6	2-3	2-3	17 75
..	Missing Link Guano, manufactured by Read Phosphate Co., Nashville, Tenn	200	1.02-1.55	6-8	4-6	2-3	2-3	14 85
..	Up to Date Guano, manufactured by Read Phosphate Co., Nashville, Tenn	200	.823-1.28	6-8	4-6	2-3	1-2	18 80
..	Peterkin's Improved Formula, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	8-10	4-6	2-3	2-3	14 00
..	Dissolved Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn	200	....	6-7	4-5	2-3	2-3	12 00

Guaranteed Analyses of Commercial Fertilizers, filed in the Office of the Commissioner of Agriculture, by Dealers and Manufacturers,

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guarantee Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1960 Oct. 1	Available Bone Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn.	200	......	9-10	5-6	2-3	......	$ 14 00
..	Electric Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn	200	......	8-9	4-5	2-3	......	12 00
..	Read's Bone and Potash, manufactured by Read Phosphate Co., Nashville. Tenn	200	......	8-10	2-3	10-12	2-3	12 00
..	Adair's Acid Phosphate, manufactured by A. D. Adair and McCarty Bros, Atlanta, Ga	200	......	7-9	3-4	2-4	......	10 00-13 00
..	Acid Phosphate and Pot., manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	......	7-9	3-4	2-4	1-2	11 00-14 00
..	Ammoniated Dissolved Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	1.75-2.50	5-8	3-4	2-4	2-3	14 90-17 00
..	Adair's Soluble Pacific Guano, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	1.75-2 50	7-8	3-4	2-4	2-3	16 60-19 00
..	Planters' Soluble Fertilizer, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	300	1.75-2 50	5-8	3-4	2-4	2-3	14.90-17 00
..	McCarty's Soluble Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	83-1.25	7-8	3-4	2-4	1-2	13 88-16 00
..	Adair's Special Potash Mixture, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	......	5-8	3-4	2-4	4-6	12 00-15 00

..	Adair's Formula, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	......	7–9	3–4	2–4	2–3	12 00–15 00
..	McCarty's Potash Formula, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	7–9	3–4	2–4	2–3	12 00–15 00
..	Special Bone and Potash Compound, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	7–8	3–4	2–4	4–6	14 00–17 00
..	Adair's Soluble Bone and Potash, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	....	7–8	3–4	2–4	2–3	12 00–15 00
..	Adair's H. G. Dissolved Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga	200	......	9–12	3–4	2–4	......	12 00–15 00
..	Furman Acid Phosphate, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	....	7–9	3–4	2–4	.....	10 00–13 00
..	Furman Acid Phosphate and Potash, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	......	7–9	3–4	2–4	1–2	11 00–14 00
..	Furman High Grade Fertilizer, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	1 75–2.50	7–8	3–4	2–4	2–3	16 90–19 00
..	Buffalo Bone Fertilizer, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	1.75–2.50	5–8	3–4	2–4	2–3	14 90–17 00
..	Furman Soluble Bone, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	88–1.25	7–8	3–4	2–4	1–2	13 38–16 00
..	Farish Furman Formula, manufactured by Furman Farm Improvement Co., Atlanta, Ga	200	....	7–9	3–4	2–4	2–3	12 00–15 00
..	Furman's H. G. Dissolved Bone, manufactured by Furman Farm Improvement Co., Atlanta Ga	200	......	9–12	3–4	2–4	......	12 00–15 00
..	Swift's Special G. Guano, manufactured by Swift's Fertilizer W'ks, Atlanta, Ga	200	4.12	7–9	2–4	1–3	3	24.03
..	Swift's Monarch H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	3.29	6–8	2–4	1–3	4	21.21
..	Swift's Cotton King H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	2.47	7–9	2–4	1–3	2	17 92
..	Swift's Eagle H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	1.65	7–9	2–4	1–3	2	16 62
..	Swift's Golden Harvest S. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	1.65	6–8	2–4	1–3	2	14 62

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture, by Dealers and Manufacturers.

When Received.	Name of Fertilize. or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
				Phosphoric Acid				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	Swift's Pioneer S. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	1.24	7–9	2–4	1–3	1	$ 14 47
..	Swift's Cotton Plant S G. Guano, manufactured by Swift's Fertilizer Works, Atlanta Ga	200	1.65	7–9	2–4	1–3	1	14 62
..	Swift's Plow Boy S G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.82	7–9	2–4	1–3	1	13 80
..	Swift's Homestead H. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	8–10	2–4	1–3	4	14 00
..	Swift's Plantation S. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	8–10	2–4	1–3	4	14 00
..	Swift's Wheat Grower S. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	8–10	2–4	1–3	2	12 00
..	Swift's Atlanta L. G. P. & P., manufactured by Swift's Fertilizer Works. Atlanta, Ga	200	....	8–10	2–4	1–3	1	11 00
..	Swift's Capital H. G. A. Phos., manufactured by Swift's Fertilizer Works. Atlanta, Ga	200	....	10–12	2–4	1–3	......	14 00
..	Swift's Chattahoochie S. G. A. Phos., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	....	10–12	2–4	1–3	......	12 00

1900 Oct. 1	Swift's Empire Std. Guano, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	1.65	6–8	2–4	1–3	2	14 62
"	Swift's Dixie Std. Phos. and Pot., manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	......	8–10	2–4	1–3	2	12–00
"	Swift's German Kainit, manufactured by Swift's Fertilizer Co., Atlanta, Ga	100	......	.....	.....	......	12	11 00
"	Swift's Ground Bone and Blood, manufactured by Swift's Fertilizer Co., Atlanta Ga.	200	18.18	16%	Amo.	......	......	36 00
"	Swift's Muriate Potash, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	......	.....	.....	......	50	50 00
"	Swift's Ground Tankage, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	7.31	Amo.	......	9%	......	22 46
"	Swift's Nitrate of Soda, manufactured by Swift's Fertilizer Co., Atlanta, Ga	200	15.65	Amo.	......	19%	......	43 83
"	Bone and Potash, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	......	6	4	1	2	12 00
"	Eagle Ammoniated Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	1 65	6	2	1	2	14 62
"	Eagle Beef, Blood and Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	.82	7	8	1	1	18 29
"	Teague's Beef Blood and Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	.82	7	3	1	1	18 29
"	Teague's Bone and Potash, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	......	7	3	1	2	12 00
"	Teague's Acid Phos., manufactured by Louisville Fertilizr Co., Louisville, Ky	200	......	8	4	1	...	12 00
"	Eagle Guano, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	1.65	7	3	1	2	16 62
"	Eagle Dissolved Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky	200	......	10	4	1	......	14 00
"	Eagle Acid Phos., manufactured by Louisville Fertilizer Co., Louisville, Ky	200	......	8	4	1	......	12 00
"	Ox Potash Formula, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	......	7	8	1	4	14 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid: Water Soluble.	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Ox Potash Special, manufactured by Tennesee Chemical Co., Nashville, Tenn	200	....	6	2	1	4	$ 12 00
..	Ox Potash Formula, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	....	8	2	1	4	14 00
..	Ox H. G. Amoniated Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	1.65	6	4	1	2	16 62
..	Ox Cotton Grower, Manufactured by Tennessee Chemical Co., Nashville, Tenn	200	1 65	6	4	1	1	15 62
..	Ox Special Wheat and Corn Guano, manufactured by Tennesee Chemical Co., Nashville, Tenn	200	.85	9	3	1	1	15 38
..	Ox Bone with Ammonia and Potash, manufactured by Tennessee Chemical Co, Nashville, Tenn	200	.85	6	4	1	1	13 38
..	Ox Slaughter House Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	1.65	6	2	1	2	14 62
..	Ox H. G Diss Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	......	8	6	1	.....	14 00
..	Ox Alkaline Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	....	9	3	1	2	14 00
..	Ox Bone and Potash, manufactured by Tennessee Chemical Co., Nashville, Tenn	200	....	7	5	1	1	13 00

..	Ox Potash Mixture, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	....	8	2	1	2	12 00
..	Ox Acid Phosphate, manufactured by Tennessee Chemical Co., Nashville Tenn.	200	....	7	5	1	....	12 00
..	Ox Potash Acid, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	....	8	2	1	1	11 00
..	Ox Special Truck Guano, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	3.30	8	2	1	4	28 24
..	Complete Fertilizer, manufactured by Scholze Bros., Chattanooga, Tenn.	200	1.70	7	2	2	2	15 76
..	Truck Farmer's Friend, manufactured by Scholze Bros., Chattanooga, Tenn.	200	1.70	7	2	2	4	17 76
..	Acid Phosphate, manufactcred by Scholze Bros., Chattanooga, Tenn.	200	....	12	2	1	......	14 00
..	Marietta H. G. Acid Phosphate, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	12-14	2-3	2-3		16 10
..	Marietta H. G. Acid Phosphate with Potash, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	8-10	2-3	2-3	1.25-2.25	18 13
..	Piedmont Acid Phosphate, manufactured by Marietta Guano Co., Atlanta Ga.	200	......	10-12	2-3	2-3	.....	18 80
..	Magic Cotton Grower, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	8-10	2-3	2-3	1-2	16 00
..	Beef Blood and Bone Compound, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	8-9	2-3	1-3	1.25-2 25	16 65
..	Disolved Bone with Potash, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	7-9	2-3	2-3	2-4	12 95
..	Same for Wheat, manufactured by Marietta Guano Co., Atlanta, Ga.	200	....	7-9	2-3	2-3	2-4	12 95
..	Wheat and Clover Grower, manufactured by Marietta Guano, Co., Atlanta, Ga	200	....	10-12	2-3	2-3	2-4	16 40
..	Golden Grain Grower, manufactured by Marietta Guano Co., Atlanta, Ga	200	....	6-8	2-3	2-3	4-6	14 40
..	M. Y. C. H. G. Dis. Bone, manufactured by Marietta Guano Co., Atlanta, Ga	200	....	8-10	2-3	2-3	2-4	14 10

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Planters Pride Guano, manufactured by Marietta Guano Co., Atlanta, Ga	200	1.75	7	2	1–3	1.25–2.25	17 50
..	Solid South Guano. manufactured by Marietta Guano Co., Atlanta, Ga	200	1.75	7	2	1–3	1.25–2.25	17 58
..	Lee Fertilizer, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.75	8	1	2	2.00	15 90
..	XX Blood and Bone, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.00	8	1	2	1.00	12 80
..	High Grade Guano, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.50	7	2	2	1.75	14 95
..	Old Time Guano, manufactured by Trawick & Jernigan, Opelika, Ala	200	1.25	7	1	2	1.00	12 50
..	XXX Ammoniated Dissolved Bone, manufacturedby Trawick & Jernigan, Opelika, Ala	200	.82	8	1	2	1.00	12 29
..	Dissolved Bone, manufactured by Trawick & Jernigan, Opelika, Ala	200	......	12	1	2	......	18 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala	200	......	10	2	2	1	18 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala	200	......	10	2	1	1	12 00

..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	9	2	2	2	18 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan. Opelika, Ala.	200	....	9	1	2	2	12 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan. Opelika, Ala.	200	....	9	1	2	8	18 00
..	Dissolved Bone and Potash manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	8	1	2	8	12 00
..	H.G. English Acid, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	12	2	2	2	14 00
..	Dissolved Bone, manufactured by Trawick & Jernigan, Opelika, Ala.	200	....	11	1	2	......	12 00
..	Dale County Standard Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	1.20	7	2	1	2	16 80
..	Ozark High Grade Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	1.20	7	2	1	2	16 80
..	Complete Cotton Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	1.65	6	1.70	1	2	14 62
..	Ozark High Grade Phosphate, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	....	8	11	2	......	14 00
..	English Acid Phosphate, McDonald, imported by Troy Fertilizer Co., Troy, Ala.	200	....	11	3	......	......	14 00
..	Blood and Bone, McDonald, imported by Troy Fertilizer Co., Troy, Ala.	200	1.65	7	2	....	2	15 62
..	English Dissolved Bone, Buford & Co., imported by Troy Fertilizer Co., Troy, Ala.	200	....	11	3	......	......	14 00
..	Dissolved Bone and Potash, manufactured by The Troy Fertilizer Co., Troy, Ala.	[illegible]	....	7	2	.....	8	12 00
..	Acid Phosphate and Potash, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	....	7	2	......	8	12 00
..	German Kainit, manufactured by The Troy Fertilizer Co. Troy, Ala.	200	....	....	....	.....	12	12 00
..	The Troy Acid Phosphate, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	......	10.50	2.50	.....	......	18 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid: Water Soluble.	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble	Potash.	Relative Commercial Value.
1900 Oct. 1	H. G. Acid Phosphate, manufactured by the The Troy Fertilizer Co., Troy, Ala.	200	....	11	8	.....	....	$ 14 00
..	Pelican R. B Guano, manufactured by Standard G & C. Mfg. Co., New Orleans. La.	100–200	1.65–2.50	4–5	4–5		1.50–3	
..	Miss. Home Guano, manufactured by G. & G. Mfg. Co., New Orleans, La	100–200	1.65–3.29	4–6.50	5–6.50	.	24.25	
..	Blood, Bone and Meat Guano, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.	100–200	1.70–2.67	4–8	4.25–6.25	.....	24.25	
..	Stern's Am. R. B. Sup. Phos, manufactured by Standard G, & C. Mfg Co, New Orleans, La.	100–200	1.65–2.50	4–5	5.00–5.50	.....	1.50–3	
..	Standard Am. Sol. Guano, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.	100–200	1.65–3.50	4–5	4–5	.....	1.50–3	
..	Champion Farmers' Choice, manufactured by Standard G. & C, Mfg. Co., New Orleans, La.	100–200	1.65–2.50	4–5	4–5	......	1.50–3	
..	Ground Bone, manufactured by Standard G. & C. Mfg Co., New Orleans, La	100–200	2.50–3.25	....		18 50–21.00	......	
..	Dissolved Bone, manufactured by Standard G. & C. Mfg. Co., New Orleans, La	100–200	.....	13–14	2–5	.....	......	
.	Acid Phosphate, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.	100–200	....	10–12	2–4	......	.....	

..	Kainit, Manufactured by Standard G. & C. Manufacturing Co., New Orleans, La.	100–200	....	......	.....	.....	12–14	
..	Farmers Alliance, manufoctured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	....	2	15 62
..	Blood and Bone, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	6.50	1.50	......	2	14 62
..	Dundee Guano, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	.82	8	2	......	1	18.30
..	Old Homestead, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	.82	8	2	....	1	13 30
..	Big Hit Guano, manufactured by The Troy Fertilizer Company, Troy, Ala	200	.82	8	2	.....	1	13 30
..	Troy Perfect, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	.....	2	15 62
..	Nancy Hanks, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	......	2	15 62
..	Meal Mixture, manufactured by The Troy Fertilizer Company, Troy, Ala	200	1.65	7	2	....	2	15 62
..	Hume's Am. Dissolved Bone, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	1.65	7	2	....	2	15 62
..	Pike's Pride, manufactured by The Troy Fertilizer Company, Troy, Ala	200	1.65	7	2	.....	2	15 62
..	Soluble Blood and Bone Guano, manufactured by The Troy Fertilizer Company, Troy, Ala.	200	.82	8	2	.....	1	13 30
..	Soluble Pacific Guano, manufactured by the Pacific Guano Co., Boston, Mass., and Charleston, S. C.	200	1.75	6.50	2.00	2.00	1.00	14 40
..	Meridian Home Mixture, manufactured by Meridian Fertilizer Factory, Meridian Miss.	200	1.35	7.50	1.50	.75	2.00	15 12
..	Meridian Blood and Bone, manufactured by Meridian Fertilizer Factory, Meridian, Miss.	200	1.65	7.50	1.50	.75	2.00	15 12
..	Meridian Farmers' Friend, manufactured by Meridian Fertilizer Factory, Meridian, Miss.	200	1.25	7.50	1.50	.75	1.00	13.12
..	Meridian Southern Phosphate, manufactured by Meridian Fertilizer Factory, Meridian, Miss	200	......	12.00	2.00	1.00	....	14 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received-	Name of Fertilizer or Chemical, by Whom Manufactured. and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
				Phosphoric Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble	Potash.	
1900 Oct. 1	Meridian English Phos. manufactured by Meridian Fertilizer Factory, Meridian, Mississippi	200	....	8.00	2.00	1.00	.....	$12 00
..	Bowker Cotton Fertilizer, manufactured by Bowker Fertilizer, Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Naston Guano. manufactured by Bowker Fertilizer Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Crown Guano, manufactured by Bowker Fertilizer Co., Elizabeth, N J	200	1.65	6	2	2	1	14 62
..	Bowker Sure Crop Fertilizer, manufactured by Bowker Fert. Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Dis. Bone Phos., manufactured by Bowker Fert. Co., Elizabeth, N. J	200	....	10	2	2	......	12 00
..	Bowker Dis. Bone with Potash, manufactured by Bowker Fert. Co., Elizabeth, N. J	200	....	8	2	2	2	12 00
..	Kainit, manufactured by Bowker Fertilizer Company, Elizabeth, N. J	....	....	.....	......	......	12	12 00
..	Ashepoo Fert., manufactured by Ashepoo Ferts. Co., Charleston, S. C	200	1.75	6 25	2.25	2.00	1.00	14 40
..	Eutaw Fertilizer, manufactured by Ashepoo Ferts. Co., Charleston, S. C	200	1.75	6.25	2.25	2 00	1.00	14 40

Oct. 1	Ashepoo Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	2.10	6.00	2.00	1.00	1.00	14 88
..	Eutaw Blood and Bone Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11 88
..	Ashepoo Blood and Bone Guano, manufactured by Ashepoo Fertz Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11.88
..	Ashepoo Dis. Bone with Am. and Potash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11 88
..	Eutaw Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	1.75	6.25	2.25	2.00	2.00	15 40
..	Enon Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	2.00	2.00	12 50
..	Pioneer Acid Phos,, manufactured by Ashepoo Fert.. Co., Charleston, S. C	200	....	8.50	2.00	2.00	1.00	11 50
..	Ashepoo Bone Ash, manufactured by Ashpoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	1.00	1.00	11.50
..	Ashepoo XX Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	9.50	2.50	2.00	......	12 00
..	Eutaw XX Acid Phos., manufactured by Ashepoo Fertz Co., Charleston, S. C	200	....	9.50	2.50	2.00	......	12 00
..	Bronwood Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	6.00	2.00	2.00	4.00	12 00
..	Eutaw Acid with Potash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2 00	2.00	1.00	11 50
..	German Kainit, manufactured by Ashepoo Fertz. Co., Charleston, S C	200	....	....	....	......	11.00	11 00
..	Carolina Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	6.00	2.00	2.00	4.00	12 00
..	Coomassie A. P. with Potash, manufactured by Ashepoo Fertz. Co., Charleston, S C	200	....	9.50	2.50	1.00	2 00	14 00
..	Ashepoo Acid Phos. with Potash, manufactured by Ashepoo Fertz Co., Charleston, S. C	200	....	8.50	2.00	2.00	1.00	11 50
..	Ashepoo Acid Poash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	1.00	......	10 50

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble		
1900 Oct. 1	Meridian English Phos. manufactured by Meridian Fertilizer Factory, Meridian, Mississippi	200	....	8.00	2.00	1.00	.....	$12 00
..	Bowker Cotton Fertilizer, manufactured by Bowker Fertilizer, Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Naston Guano. manufactured by Bowker Fertilizer Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Crown Guano, manufactured by Bowker Fertilizer Co., Elizabeth, N J	200	1.65	6	2	2	1	14 62
..	Bowker Sure Crop Fertilizer, manufactured by Bowker Fert. Co., Elizabeth, N. J	200	1.65	6	2	2	1	14 62
..	Bowker Dis. Bone Phos., manufactured by Bowker Fert. Co., Elizabeth, N. J	200	....	10	2	2	.....	12 00
..	Bowker Dis. Bone with Potash, manufactured by Bowker Fert. Co., Elizabeth, N. J	200	....	8	2	2	2	12 00
..	Kainit, manufactured by Bowker Fertilizer Company, Elizabeth, N. J	....	....	.....	......	......	12	12 00
..	Ashepoo Fert., manufactured by Ashepoo Ferts. Co., Charleston, S. C.	200	1.75	6 25	2.25	2.00	1.00	14 40
..	Eutaw Fertilizer, manufactured by Ashepoo Ferts. Co., Charleston, S. C	200	1.75	6.25	2.25	2 00	1.00	14 40

Oct. 1	Ashepoo Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	2.10	6.00	2.00	1.00	1.00	14 88
..	Eutaw Blood and Bone Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	.85	6.00	2.00	8.00	1.00	11 88
..	Ashepoo Blood and Bone Guano, manufactured by Ashepoo Fertz Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11.38
..	Ashepoo Dis. Bone with Am. and Potash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	.85	6.00	2.00	3.00	1.00	11 38
..	Eutaw Guano, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	1.75	6.25	2.25	2.00	2.00	15 40
..	Enon Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	2.00	2.00	12 50
..	Pioneer Acid Phos,, manufactured by Ashepoo Fert.. Co., Charleston, S. C	200	....	8.50	2.00	2.00	1.00	11 50
..	Ashepoo Bone Ash, manufactured by Ashpoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	1.00	1.00	11.50
..	Ashepoo XX Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	9.50	2.50	2.00	......	12 00
..	Eutaw XX Acid Phos., manufactured by Ashepoo Fertz Co., Charleston, S. C	200	....	9.50	2.50	2.00	......	12 00
..	Bronwood Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	6.00	2.00	2.00	4.00	12 00
..	Eutaw Acid with Potash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2 00	2.00	1.00	11 50
..	German Kainit, manufactured by Ashepoo Fertz. Co., Charleston, S C	200	....	....	....	......	11.00	11 00
..	Carolina Acid Phos., manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	6.00	2.00	2.00	4.00	12 00
..	Coomassie A. P. with Potash, manufactured by Ashepoo Fertz. Co., Charleston, S C	200	....	9.50	2.50	1.00	2 00	14 00
..	Ashepoo Acid Phos. with Potash, manufactured by Ashepoo Fertz Co., Charleston, S. C	200	....	8.50	2.00	2.00	1.00	11 50
..	Ashepoo Acid Potash, manufactured by Ashepoo Fertz. Co., Charleston, S. C	200	....	8.50	2.00	1.00	......	10 50

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Eutaw Acid Phosphate, manufactured by Ashepoo Fertilizer Co., Charleston, S. C	200	....	8.50	2 00	1.00	.....	10 50
..	Coomassie Acid Phosphate, manufactured by Ashepoo Fertilizer Co. Charleston, S. C	200	....	9.50	2.50	2.00	.....	12 00
..	Blood and Bone and Potash, manufactured by New Orleans Acid and Chemical Co., New Orleans, La	200	.823	7.00	3	2	1	13 30
..	Acid Phosphate with 4% Potash, manufactured by Potapsco Guano Co., Baltimore, Md	200	....	5.00	3	2	4	12 00
..	Ammoniated Dissolved Bone and Potash, manufactured by Dothan Guano Co., Dothan, Ala	200	.823	8.00	2	2	2	14 30
..	Standard Grade Corn and Cotton Compo., manufactured by Dothan Guano Co., Dothan, Ala	200	1.65	7.00	2	1	2	15 62
..	Standard Grade Grange Mixture, manufactured by Dothan Guano Co., Dothan, Ala	200	1.65	5.50	2	1	3	15 12
..	Peterman's Leader, manufactured by Dothan Guano Co., Dothan. Ala	200	.82	8.00	2	1	1	13 30
..	Grange Mixture, manufactured by Dothan Guano Company. Dothan, Ala	200	1.65	5.50	1 25	1	3	14 37
..	Corn and Cotton Compound, manufactured by Dothan Guano Co., Dothan, Ala	200	1.65	7.00	1.00	1	2	14 62

Howell's Fruit Food, manufactured by Dothan Guano Company, Dothan, Ala	200	1.50	5.50	2.00	1	8.1-2	15 20
Phosphate with 8% Potash, manufactured by Dothan Guano Co, Dothan, Ala	200	....	8.00	1.50	1	3	12 50
High Grade Acid Phosphate, manufactured by Dothan Guano Co. Dothan, Ala	200	.... ..	11.00	2.00	1	.....	18 00
Blood and Bone Fertilizer, manufactured by Dothan Guano Co, Dothan, Ala	200	1.65	7.00	2.00	1	2	15 62
Ammoniated Dissolved Bone, manufactured by Dothan Guano Co., Dothan, Ala	200	.82	8.00	2.00	1	1	18 30
Genuine German Kainit, manufactured by Dothan Guano Co., Dothan, Ala	200	.... ..	......	......	....,	12%	12 00
B. D. Seafowl Guano, manufactured by Bradley Fertilizer Co., Charleston, S. C	200	1.85	6.50	2.50	2.00	1.00	15 18
Bradley's Patent Superphosphate, manufactured by Bradley Fertilizer Co., Charleston, S. C.	200	1.85	6.50	2.50	2.00	1.00	15 18
Ammoniated Dissolved Bone, manufactured by Bradley Fertilizer Co, Charleston, S. C	200	1.65	6.00	2.00	2.00	1.00	18 62
Eagle Am Bone Superphosphate, manufactured by Bradley Fertilizer Co., Charleston, S. C	200	1.65	6 00	2.00	2.00	1.00	18 62
Bradley's Palmetto Acid Phosphate manufactured by Bradley Fertilizer Co., Charleston, S. C	200	....	9.00	8 00	2 00	.....	12 00
Cow Phosphate Acid, manufactured by Cullman Cotton Company. Cullman, Ala	200	....	12-18	1-2	2-3	......	18 00
Bull Phosphate Acid, manufactured by Cullman Cotton Company, Cullman, Ala	200	....	12-14	2-4	1-3	......	11 00
Corn and Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82-100-1	......	... ..	10-11	1.1-15	18 30
Cow Guano, manufactured by Cullman Cotton Company, Cullman, Ala	200	1.65-2	......	......	10-12	1.1-15	15 62
Guano No. 8—P., manufactured by Cullman Cotton Company, Cullman, Ala	200	....	8	2	. ..	4	14 00
Guano No. 3—S., manufactured by Cullman Cotton Company, Cullman, Ala	200	1.65	6	2	......,	2	14 62

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture, by Dealers and Manufacturers.

When Received.	Name of Fertilize. or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Best Made, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1.17	2	$16 62
..	Cow Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8.21	1.79	1.82	1	15 62
..	Corn and Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82	7.85	2.65	1.83	1	18 80
..	Cow Acid Phosphate, manufactured by Cullman Cotton Co, Cullman, Ala	200	......	12½	1½	2½	......	15 00
..	Bull Acid Phosphate, manufactured by Cullman Cotton Co., Cullman, Ala	200	......	12½	2½	1½	......	14 00
..	No. 5 B Phosphate, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	7	2	....	2	15 62
..	No. 6 A., manufactured by Cullman Cotton Co., Cullman, Ala	200	1.50	7	2	.....	2	15 20
..	No. 9 C., manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	.....	1	15 62
..	Guano 16. P., manufactured by Cullman Cotton Co., Cullman, Ala	200	......	12	....	.....	4	16 00
..	Mountain City Lint, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82	6	4	1	4	16 80

Oct. 1	Mountain City Lint, No. 2, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	6	4	1	4	18 60
..	Corn and Cotton Lint No. 2, manufactured by Cullman Cotton Co., Cullman, Ala	200	1 65	10	2	......	2	16 60
..	No. 1024, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	4	18 60
..	No. 735, manufactured by Cullman Cotton Co., Cullman, Ala	200	2.50	6	1	1	5	19 00
..	No. 1034, manufactured by Cullman Cotton Co., Cullman, Ala	200	2.50	8	2	1	4	21 00
..	No. 1023, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	3	17 62
..	No. 823, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	6	2	1	3	15 62
..	No. 822, manufactured by Cullman Cotton Co., Cullman, Ala	200	1 65	6	2	1	2	14 62
..	No. 1022, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	2	19 62
..	No. 922, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	7	1.50	1	2	15 12
..	No. 1021, manufactured by Cullman Cotton Co., Cullman, Ala	200	1.65	8	2	1	1	15 62
..	No. 1014, manufactured by Cullman Cotton Co., Cullman, Ala	200	.82	8	2	1	4	16.30
..	Acid and Potash No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga	200	......	8	2	2	2	12 00
..	Acid and Potash No. 12-2, manufactured by Home Mixture Guano Co., Columbus, Ga	200	......	8	4	2	2	14 00
..	Acid and Potash No. 4, manufactured by Home Mixture Guano Co., Columbus, Ga	200	......	6	2	2	4	12 00
..	Home Mixture No 1, manufactured by Home Mixture Guano Co, Columbus, Ga	200	1.65	7	2	2	1	14 62
..	Home Mixture No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga	200	1.65	6	2	2	2	14 62

Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package	Guaranteed Analyses					Relative Commercial Value.
				Phosphoric Acid.				
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900 Oct. 1	Home Mixture No 3, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	1.65	8	2	2	2	$ 16 62
..	Home Mixture No 4, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	1.65	6	2	2	4	16 62
..	Acid Phosphate No. 1, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	......	10	2	2	......	12 00
..	Acid Phosphate No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	......	12	2	2	.....	14 00
..	Potatoe Mixture, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	1.65	4	2	1	6	16 62
..	Kainit, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	......	....	....	....	12	12 00
..	Goldsmith Imported Mixture, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	7.00	2.00	2 00	1.00	14 62
..	Gold Dust, manufactured by New Orleans Acid and Fertilizer Co., Greta, La.	200	1.65	7.00	2.00	2.00	1.00	14 62
..	Blood, Bone and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	7.00	2.00	2.00	1.00	14 62
..	Good Luck, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	7.00	2.00	2.00	1.00	14 62

.	Dixie Soluble Bone and Potash with Ammonia, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	6.00	1.00	2.00	1.00	12 62
..	Diss. Bone and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	....	8.00	2.00	2.00	2 00	12 00
..	Acid and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	......	8.00	2.00	2.00	4.00	14 00
..	Black Diamond Acid Phosphate, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	.....	10.00	2.00	2.00	....	12 00
..	Crescent City Acid Phosphate, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La	200	.....	10.00	2.00	2.00	.....	12 00
..	W. O. C. A. Pure Blood Guano, manufactured by Coweta Fertilizer Co., Newnan and Columbus, Ga	167	1.65	8	2	1	2	16 62
..	Coweta H. G. Fertilizer, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga	200	1.65	8	2	1	2	16 62
..	Coweta Animal Bone, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga	200	1.65	6	2	1	2	14 62
..	Sea Bird Guano manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co. Newnan, Ga	200	1.65	6	2	1	2	14 62
..	Aurora Amo. Phosphate, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga	200	1.65	7	2	1	1	14 62
..	Coweta Stand. Dis. Bone and Potash, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	......	8	2	1	2	12 00
..	Coweta Wheat and Grass Grower, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	....	8	2	1	2	12 00
..	Coweta H. G. Acid Phosphate, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga	200	......	12	2	1	......	14 00
..	Coweta Standard Acid Phosphate, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga	200	.....	10	2	1	....	12 00
..	Coweta Diss. Bone, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga	200	......	10	2	1	......	12 00
..	I. A. P. Bone with Amonia and Potash, manufactured by Coweta Chemical Co., Branch Virginia-Car Chemical Co., Newnan, Ga.	200	.83	8	2	1	1	18 81
..	18 & 14 Diss. Bone and Potash, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga	200	....	11	2	1	4	17 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis: Nitrogen.	Phospporic Acid: Water Soluble.	Phospporic Acid: Citrate Soluble.	Phospporic Acid: Acid Soluble.	Potash.	Relative Commercial Nalue.
1900 Oct. 1	10 & 4 Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	......	8	2	1	4	$ 14 00
..	8 & 4 Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	......	6	2	1	4	12 00
..	Coweta Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	......	10	2	1	2	14 00
..	German Kainit, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.	200	....	....	....	....	12	12 00
..	Muriate of Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga.	....	...	....	....	....	48	48 00
..	Old Dominion Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga.	200	1.65	6	2	2	1.50	14 12
..	Southern Amd. Dissolved Bone Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga.	200	1 65	6	2	2	1	18 62
..	Patent Pacific Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga.	200	1.65	6	2	2	1	18 62
..	Etowah Guano, manufactured by Old Dominion Guano Co, Atlanta, Ga.	200	.85	6	3	2	1	12 88
..	Blood and Bone Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga.	200	.85	6	3	2	1	12 88

Old Dominion Dissolved Bone, manufactured by Old Dominion Guano Co, Atlanta, Ga	200	....	10	2	2	......	12 00
Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion, Guano Co., Atlanta, Ga	200	....	8	2	2	2	12 00
Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion Guano Co., Atlanta Ga	200	....	6	2	2	4	12 00
Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion Guano Co, Atlanta, Ga	200	....	8	2	2	4	14 00
Bear H. G. Dissolved Bone, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	8	6	1	......	14 00
Bear H. G. Beef Blood and Bone, manufactured by Continental Fertilizer Co. Nashville, Tenn	200	1.65	6	2	1	2	16 62
Bear Special Wheat and Corn Grower, manufactured by Continental Fertilizer Co, Nashville, Tenn	200	......	8	3	1	2	13 00
Bear Bone and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	......	9	3	1	1	13 00
Bear Potash mixture, manufactured by Continental Fertilizer Co, Nashville, Tenn	200	....	8	2	1	2	12 00
Eddystone Soluble Guano, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	1.65	7	2	1	1	14 62
Eddystone Dissolved Bone, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	10	3	1	.....	13 00
Eddystone Bone and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	7	5	1	1	13 00
Eddystone Potash Mixture, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	7	3	1	2	12 00
Sunny South Acid Phosphate, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	10	3	1	......	13 00
Bear Phosphate and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	....	8	2	1	1	11 00
Eddystone Cotton Guano, manufactured by Continental Fertilizer Co., Nashville, Tenn	200	.85	6	4	1	1	13 38
Etiwan H. G. Acid Phosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C	200	....	11–13	2–3	2	......	13 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble	Citrate Soluble.	Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Etiwan Acid Phosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	......	10–12	2	2	.....	12 00
..	Plow Brand Raw Bone Superphosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	1.64	6–8	2–3	2	2–3	14 60
..	Diamond Soluble Bone, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	......	11–13	2–3	2	.....	13 00
..	Plow Brand Soluble Fertilizer, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	1.64	7–9	2–3	2	1–2	14 60
..	American Ammoniated Bone Superphosphate, manufactured by Williams & Clark Fertilizer Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62
..	Cumberland Bone Superphosphate of Lime, manufactured by Cumberland Bone Phosphate Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62
..	Goulding's Vegetable Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	3.30	5	2	1	4	20 24
..	Goulding's H. G. Acid Phosphate, manufactured by The Goulding Fertilizer Co. Limited, Pensacola, Fla.	200	......	12	3	1	.....	15 00
..	Goulding's Atlas Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	209	......	10	3	1	....	13 00
..	Goulding's Mixture, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	......	10	2	1	.....	14 00

..	Genuine German Kainit, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	....	....	....	12	12 00
..	Goulding's H. G Phosphate and Potash, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	10	2	1	1	18 00
..	Goulding's Bone Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	8	1	1.50	15 12
..	Goulding's Special Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	8	1	1.50	15 12
..	Goulding's Ammoniated Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	8	1	1.50	15 12
...	Goulding's English Bone Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1 65	6	8	1	1.50	15 12
..	Goulding's St. George Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.85	7	2	1	1.50	12 88
..	Winkler H. G. Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	12	8	1	....	15 00
..	A. G. Winkler's Ammoniated Dissolved Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	8	1	1.50	15 12
..	Gem Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola Fla.	200	1.65	5	8	1	2	14 62
..	English Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola Fla.	200	....	9	8	1	1.50	12 00
..	Samson Ammoniated Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	8	1	1.50	15 12
..	Samson Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	10	8	1	....	18 00
..	Goulding's 3% Potash Acid, manufactured by The Goulding Fertilizer Co. Limited, Pensacola, Fla.	200	...	6	2	1	8	11 00
..	Goulding's 4% Potash Acid, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	6	2	1	4	12 00
..	Goulding's XXX Potash Acid, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	....	12	2	1	2	16 00
..	Tucker, Willinghanm & Co's Special H. G. Potash Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.85	7	8	1	3	15 88

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Earle Terrell & Co. H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Earle Terrell & Co. H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	......	11-13	2-3	2	.....	13 00
..	Earle Terrell & Co Bone and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	....	8-10	2-3	2	2-3	12 00
..	Dadeville Oil Mill H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	....	10-12	2-3	2	...	12 00
..	Cahaba Acid Phos. and Pot Mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	....	8-10	2-3	2	2-3	12 00
..	Cahaba Potash Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	....	8-10	2-3	2	4-5	14 00
..	Cahaba Bone Ash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	....	6-8	2-3	2	4-5	12 00
..	Cahaba Soluble Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	......	6-8	2-3	2	1-2	11 80
..	Cahaba Dis. Bone Am. and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	....	8-10	2-3	2	1-2	18 80
..	Cahaba H. G. Blood, Bone and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	1.64-2.46	8-10	2-3	2	2-3	16 60

..	Cahaba H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-8	2	2-8	16 60
..	Cahaba Soluble Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-8	2	1-2	14 90
..	Cahaba Standard Grade Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	1.64-2.46	7-9	2-8	2	1-2	14 60
..	Birmingham H. G. Blood, Bone and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-8	2	2-8	16 60
..	Birmingham H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-8	2	2-8	16 60
..	Birmingham Soluble Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-8	2	1-2	14 60
..	Birmingham Standard Grade Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingam, Ala.	200	1.64-2 46	6-8	2-8	2	2-8	14 60
..	Birmingham Dis. Bone A. M. and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.82-100	8-10	2-8	2	1-2	18 80
..	Jefferson County Standard Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-8	2	2-8	16 60
..	Cahaba Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-8	2	...	12 00
..	Cahaba H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	11-13	2-8	2	...	13 00
..	Cahaba Dissolved Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-3	2	...	12 00
..	Cahaba H. G. Diss. Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	11-13	2-8	2	...	13 00
..	Cahaba Acid Phosphate with Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	8-10	2-8	2	1-2	11 00
..	Birmingham Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-3	2	....	12 00
..	Birmingham H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala..	200	....	11-13	2-3	2	...	13 00
..	Birmingham Dissolved Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	....	10-12	2-8	2	....	12 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Birmingham H. G. Dissolved Bone, manufactured by Birmingham, Fertilizer Co., Birmingham, Ala.	200	......	11-13	2-3	2	.....	$ 13 00
"	Birmingham Acid Phosphate with Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	8-10	2-3	2	1-2	11 00
"	Birmingham Acid Phosphate and Potash mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala	200	......	8-10	2-3	2	2-3	12 00
"	Birmingham Potash Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	8-10	2-3	2	4-5	14 00
"	Birminghham Bone and Ash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	6-8	2-3	2	4-5	12 00
"	Birmingham D Bone and Muriate Potash mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	......	10-12	2-3	2	2-3	14 00
"	Birmingham Soluble Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	82-100	6-8	2-3	2	1-2	11 30
"	Navassa Cotton Fertilizer, manufactured by Navassa Guano Co, Wilminghton, N. C	200	1.65	6.00	2.00	2 00	2.00	14 62
"	Navassa Bone and Ash, manufactured by Navassa Guano Co, Wilmington, N. C	200	......	7.00	3.00	2.00	2.00	12 00
"	Dissolved Bone with Am. and Potash, manufactured by Navassa Guano Co,, Wilmington, N. C.	2 00	.82	7.00	3.00	2.00	1.00	13 30

..	Navassa Acid Phosphate, manufactured by Navassa Guano Co., Wilmington, N. C	200	......	9.00	3.00	2.00	...	12 00
..	Acid Phosphate with Potash, manufactured by Navassa Guano Co., Wilmington, N. C	200	....	7.00	8.00	2.00	1.00	11 00
..	Navassa Complete Fertilizer, manufactured by Navassa Guano Co., Wilmington, N. C	200	1.65	6.00	3.00	2.00	1.00	14 62
..	Navassa Wheat Mixture, manufactured by Navassa Guano Co., Wilmington, N. C	200	....	7.00	8.00	2.00	4.00	14 00
..	Navassa Grain Fertilizer, manufactured by Navassa Guano Co., Wilmington, N. C	200	1.65	6.00	2.00	2.00	2.00	14 62
..	Genuine German Kainit, manufactured by Navassa Guano Co., Wilmington, N. C	200	....	....	.....	....	12.00	12 00
..	Giant Guano, manufactured by Rasin Monumental Co., Richmond, Va	200	1.65	6	2	2	2	14 62
..	Soluble Sea Island, manufactured by Rasin Monumental Co., Charleston, S. C	200	1.65	6	8	2	1	14 62
..	Rasin's Empire Guano, manufactured by Rasin Monumental Co., Atlanta, Ga	200	1.65	6	8	2	1	14 62
..	Rasin's Dixie Guano, manufactured by Rasin Monumental Co., Atlanta, Ga	200	1.65	6	2	2	2	14 62
..	Kainit, manufactured by Rasin Monumental Company, Atlanta, Ga	200	....	....	.....	....	12	12 00
..	Acid Phosphate, manufactured by Rasin Monumental Company, Atlanta, Ga	200	....	10	4	2	......	14 00
..	Bone and Potash, manufactured by Rasin Monumental Co., Atlanta, Ga	200	....	7	8	2	2	12 00
..	Dissolved Bone, manufactured by Rasin Monumental Company, Atlanta, Ga	200	1.65	7	3	2	....	14 62
..	Columbia Guano, manufactured by Columbia Fertilizer Co., Columbia, Ala	200	1.65	6	1	1	2	16 12
..	Farmer's Friend, manufactured by Columbia Fertilizer Company, Columbia, Ala	200	1 00	6	1	1	3	15 00
..	Columbia H. G Acid Phos., m'f'd by Col. Fert. Co., Columbia, Ala	200	....	10	2	1	.....	13 00
..	Dis. Bone and Potash, m'f'd by Col. Fert. Co., Columbia, Ala	200	...	6	2	1	8	13 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Receivek.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	German Kainit, manufactured by Columbia Fertilizer Co., Columbia, Ala.	200	......	......	......	......	12	$ 12 00
..	Sipsey H. G. Acid Phosphate, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	......	11	2	1	......	13 00
..	Sipsey H. G. Acid Phos. and Potash, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	......	9	1	1	2	12 00
..	Graham's Best Guano, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	2	7	2	1	2	16 60
..	Etowah Fertilizer, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	1	9	1	1	1	13 80
..	King Cotton, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	1	9	1	1	1	13 80
..	Our Best Fert. Am. D. B. & Potash, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.80	6.50	2.50	.50	2.00	13 24
..	Cotton Queen Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	167	2.06	6.50	2.00	.50	1.00	15 05
..	Cotton Queen Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	167	2.00	6.00	1.50	.50	2.00	15 10
..	Waters Special Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.30	.50	1.00	15 00

..	Walters Special Dis. Bone and Potash, manufactured by Tallapoosa Oil Co, Alexander City, Ala.	200	....	10.00	2.00	1.00	1.00	18 00
..	Coley's & Sandlin's Spe. D. B. and P., manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	....	10.00	2.00	1.00	1.00	18 00
..	Tallapoosa H. G. Acid, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	....	11.00	2.50	2 00	.....	13 50
..	Tallapoosa Dis. Bone and Potash, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.....	10.00	2.00	2.00	1.00	18 00
..	Our Best Fertilizer D. B. and P., manufactured by Tallapoosa Oil Co, Alexander City, Ala.	200	....	11.00	2.00	1.00	1.00	14 00
..	Standard Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.30	.50	1.00	15 00
..	Soluble Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	2.00	6.50	2.00	.50	1.00	15 10
..	Coley & Sandlin's Special Guano. manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.30	.50	1.00	15 00
..	Ober's Sol. Am. Sup. Phos. of Lime, manufactured by G. Ober & Sons & Co, Baltimore, Md.	200	....	6.50	1.50	2	2	15 04
..	Farmers Standard Am. Phos., manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.70	6.50	1.50	1.50	2	14 76
..	Ober's Special Am. Dis. Bone, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	1.65	6	3	3	2	15 62
..	Ober's Dis. Bone with Am. and Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	1.00	7	2	1.50	2	13 80
..	Ober's Farmers Mixture, manufactured by G. Ober & Sons Co., Baltimore, Md.	200	.75	7	2	1.50	2	13 10
..	Ober's Dis. Bone Phos. and Potash. manufactured by G. Ober & Sons & Co, Baltimore, Md	200	....	8	2	2	2	12 00
..	Ober's Acid Phos. with Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	....	6	2	2	4	12 00
..	Ober's Acid Phos. with Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	....	8	2	2	4	14 00
..	Ober's Standard Am. Dis. Bone, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.80	6	2	2	2	15 04

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble		
1900 Oct. 1	Ober's Dis Bone Phosphate, manufactured by G. Ober & Sons & Co., Baltimore, Md	200	......	11	3	2	......	$14 00
..	Randolph Fertilizer, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	2 00	6 75	1.25	1.25	1.50	15 00
..	Roanoke Guano, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	1.75	6 75	1.25	1.25	1.00	13 90
..	Pride of Alabama, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	1 65	6 75	1.25	1.25	2.00	14 62
..	Jones' Best, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	1.65	6.75	1.25	1.25	1.00	13 62
..	H. G. Cotton Grower, manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	.82	8.50	1.50	1.50	1 00	13 30
..	H. G. English Acid Phos., manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	......	10.	2.00	2.00	....	12 00
..	Potash Acid Phos., manufactured by Campbell & Wright, Jr., Roanoke, Ala	200	......	8.50	1.50	1.50	2.00	12 00
..	Ashcraft's Formula, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	......	8.75	1.25	2.76	....	12 00
..	King Cotton Grower, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	.82	10.00	......	2.15	1.00	13 35

Oct. 1	Florence Acid, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	9.67	3.38	1.98	......	18.00
..	Tiger Guano, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	8.75	1.25	2.76	2.00	12 00
..	Corn and Cotton, manufactured by Tennessee Valley Fert Co. Florence, Ala	200	1.65	10.00	....	.....	1.00	15.62
..	Tiger Acid, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	11.88	1.62	2.27	.....	18 00
..	Tiger Cotton Grower, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	.82	10.00	......	......	1 00	18 30
..	C. S. Meal and Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	1.65	10.00	......	.....	2.00	14 62
..	Blood and Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	.82	10.00	..	.....	1.00	18 30
..	H. G. Dis. Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala	200	....	12.00	....	.....	.....	12 00
..	S. and K. Am Diss. Bone, manufactured by Montgomery Fertz Co., Montgomery, Ala	200	.83	8	2	1	1	18 82
..	Kainit, manufactured by Montgomery Fert. Co., Montgomery. Ala	200	....	....	......	....	12	12 00
..	Montgomery Acid Phos. with Potash, manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	8	2	1	2	12 00
..	Meal and Phos. Compound, manufactured by Montgomery Fert. Co., Montgomery, Ala	200	1.65	7	2	1	......	18 62
..	High Grade Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	11.	2	1	.....	13 00
..	H. G. English Acid Phos., manufrctured by Montgomery Fert. Co., Montgomery, Ala	200	....	12.	2	1	....	14 00
..	Star Brand Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	11.	2	1	.....	13 00
..	Early Bird H. G. Acid Phos, manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	11.	2	1	....	13 00
..	S. and K. English Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala	200	....	11.	2	1	......	13 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package	Guaranteed Analysis: Nitrogen.	Phosphoric Acid: Water Soluble,	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble.	Potash.	Relative Commercial Value.
19.0 Oct. 1	S & O. H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Vandiver's XX Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Griel's English Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Thompson's English Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Pinckard's Home Mixture, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
..	Alliance Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	6	2	1	2	14.62
..	Crescent Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	1	14.62
..	Star Brand Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	1	14.62
..	Plow Brand Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	H. & F. H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00

..	W. L. & Co's H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Dissolved Bone and Potash, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	9	2	1	1	12.00
..	Alkaline Acid Phosphate 4% Potash, manufactured by Montgomery Fe tilizer Co, Montgomery, Ala	200	....	6	2	1	4	12.00
..	English Acid Phosphate with 2% Potash, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	10	2	1	2	14.00
..	S a Gull Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala..	200	1.65	7	2	1	2	15.62
..	Capital City Standard Fertilizer, manufactured by Montgomery Fertilizer Co, Montgomery, Ala.	200	1.65	7	2	1	2	15.62
..	Montgomery Blood and Bone Fertilizer, manufactured by Montgomery Fertilizer Co., Montgomery, Ala..	200	1.65	7	2	1	2	15 62
..	Tariff Reform Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
..	Clayton Fertilizer, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	1.65	7	2	1	2	15.62
..	Southern Pacific Guano, manufactured by Montgomery Fertilizer Co, Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Our Cotton Queen Guano, manufactured by Montgomery Fertilizer Co, Montgomery, Ala	200	.83	8	2	1	1	13.32
..	Early Bird Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Vandiver's Ammoniated Dissolved Bones, manufactured by Montgomery Fertilizer Co., Montgomery, Ala	200	.83	8	2	1	1	13.32
..	Ammoniated Dissolved Bones, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Wilson's Special Compound, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
..	Schuessler & Co., manufactured by Opelika Chemical Co., Opelika, Ala.	200	....	..	..	..	..	.....
..	Schuessler H. G. Fertilizer, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	6	2	1	2	14.62

Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package	Guaranteed Analyses: Nitrogen.	Phosphoric Acid: Water Soluble.	Phosphoric Acid: Citrate Soluble.	Phosphoric Acid: Acid Soluble.	Potash.	Relative Commercial Value.
1900 Oct. 1	Schuessler & Co. Special Formula, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.83	8	2	1	8	$ 15 82
..	Schuessler & Co. Beef Blood and Bone, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.83	8	2	1	1	18 82
..	Schuessler & Co H. G. Bone and Potash, manufactured by Opelika Chemical Co., Opelika, Ala	200	......	8	2	1	2	12 00
..	Schuessler & Co. H. G. English Acid Phos., manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	10	2	1	.....	12 00
..	Schuessler Bros. H. G. Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62
..	Schuessler Bros. H. G. Bone and Potash, manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	8	2	1	2	12 00
..	Schuessler Bros. XXX Bone and Potash, manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	9	2	1	1	12 00
..	Kainit, manufactured by Opelika Chemical Company, Opelika, Ala	200	......	....	......	.....	12	12 00
..	C. C C. Standard Fertilizer, manufactured by Opelika Chemical Co., Opelika, Ala	200	1.65	6	2	1	2	14 62
..	Diamond Soluble Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62

..	Good Luck Soluble Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.88	8	2	1	1	18 82
..	Standard Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala.	200	....	11	2	1	......	18 00
..	Opelika Acid Phos. with 2% Potash, manufactured by Opelika Chemical Co., Opelika, Ala.	200	....	8	2	1	2	12 00
..	Blood and Bone Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62
..	J. C. Adkin & Son, No. 1 Acid Phos., manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	11	2	1	.....	18 00
..	H. G. English Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala.	200	......	10	2	1	....	12 00
..	Potash Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala.	200	....	8	2	1	2	12 00
..	W. C. Bradley & Co's. Standard Guano, manufactured by Virginia-Carolina Chemical Co., Charleston, S. C.	200	1.65	6	2	2	2	14 62
..	W. C. Bradley & Co's. Soluble Guano, manufactured by Virg'a-Car. Chemical Co., Richmond, Va.	200	1.65	7	3	2	2	14 62
..	W. C. Bradley & Co's H. G. Potash Acid, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	....	9	3	2	2	14 00
..	W. C. Bradley & Co's. H. G. Acid Phosphate, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	....	10	4	2	.....	14 00
..	W. C. Bradley & Co's. Standard Pot Acid, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	....	7	3	2	2	12 00
..	T. W. & Co's Eng. H. G. Acid with Mur. Potash, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.. ...	9	3	1	1	18 00
..	T. W. & Co's. Bone and Muriate of Potash, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	....	7	3	2	2	12 00
..	T. W. & Co's. Special H. G. Potash Guano, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.82	7	3	2	3	15 30
..	T. W. & Co's Muriate of Potash Mixture, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	....	9	3	1	2	14 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers--Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured	Weight of Package.	Guaranteed Analysis.					Relative Commercial Value.
			Nitrogen.	Phosphoric Acid.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900 Oct. 1	Blanchard H. G. Acid Phos., manufactured by Virginia-Carolina Chemical Co., Atlanta, Ga.	200	....	10	4	2	.....	$14 00
..	Rome Soluble Guano, manufactured by Rome Guano Co., Rome, Ga.	200	1.65	6	2	1	2	14 62
..	Blood and Bone with Potash, manufactured by Rome Guano Co., Rome, Ga	200	.85	8	2	1	1	18.88
..	Royal Guano, manufactured by Rome Guano Co., Rome, Ga	200	1.65	8	2	1	......	14 62
..	High Bone and Potash, manufactured by Rome Guano Co., Rome, Go	200	....	8	2	1	2	12 00
..	Standard Acid Phos., manufactured by Rome Guano Co. Rome, Ga	200	....	10	2	1	......	12 00
..	National Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	.82	6	4	.....	2	18 29
..	Blood and Bone Guano, manufactured by National Fertz. Co., Nashville, Tenn	200	.82	6	4	....	2	18 29
..	Rock City Guano, manufactured by National Fertz. Co., Nashville, Tenn	200	1.64	5	8	.....	2	14 59
..	Tennessee Guano, manufactured by National Fertz. Co., Nashville, Tenn	200	1.64	5	8	......	8	14 59

Oct. 1	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	....	......	12 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	8	.....	.....	18 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	4	......	......	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	4	......	....	14 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn	300	....	11	4	......	.....	15 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	10	4	.....	......	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	11	4	......	......	15 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co, Nashville, Tenn	200	....	12	4	.....	......	16 00
..	Tennessee H. G. Dis. Bone, with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	....	6	4	......	1	11 00
..	Tennessee H. G. Dis. Bone, with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	......	8	4	......	2	14 00
..	Sadler's Formula, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	2	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	......	12 00
..	Tennessee H. G Diss. Bone and Potash, manufactured by National Fertz. Co	200	....	6	4	......	2	12 00
..	Acid Phos. with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	....	6	4	....	1	11 00
..	Acid Phos. with Potash, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	2	14 00
..	Tennessee Century Guano, manufactured by National Fertz. Co., Nashville, Tenn	200	....	8	4	......	4	16 00
..	Tennessee H. G. Acid Phos., manufactured by National Fertz. Co., Nashville, Tenn	200	....	11	4	......	......	15 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Concluded.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	Guaranteed Analysis. Nitrogen.	Phosphoric Acid. Water Soluble.	Phosphoric Acid. Citrate Soluble.	Phosphoric Acid. Acid Soluble.	Potash.	Relative Commercial Valve.
1909 Oct. 1	Old Hickory Guano, manufactured by National Fertz. Co., Nashville, Tenn	200	1.64	5	8	.....	2	$14 59
..	Old Hickory Guano, manufactured by National Fertz Co., Nashville, Tenn	200	1.64	6	4	.....	3	16 59
..	Ammoniated Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn	200	.82	6	4	.....	1	18 29
..	Alabama Fertilizer, manufactured by Alabama Fertz Co., Montgomery, Ala	200	1.80	7	1.50	.....	1.50	15 04
..	Acid Phosphate, manufactured by Alabama Fertz. Co, Montgomery, Ala	200	....	11	2	.....	.....	18 00
..	Kainit, manufactured by Alabama Fertz. Co., Montgomery, Ala	200	....	.....	....	.....	12.	12 00
..	Muriate of Potash, manufactured by Alabama Fertz. Co., Montgomery, Ala	200	....	....	....	.....	52.	52 00
..	Concentrated Tankage, manufactured by Hiller, Hirsh & Co., New York	200	18.	.....	.....	.....	....	36 40
..	Ground Blood, manufactured by Swift & Co., Chicago	200	14.	....	....	..	...	42 00

LICENSES.

The following is a list of the Licenses issued this season to July 1st, 1901, with the date when issued, number of license, and post office of the local dealers.

Date of Issue.		Name.	P. O. Address.	No. of License.
1900.				
Oct.	3	Adair & McCarty Bros	Atlanta, Ga	4
··	15	Armour Fertilizer Works	Kansas City, Mo	29
··	30	Alabama Fertilizer Co	Montgomery	37
Nov.	19	Adamson & Edwards	Ophelia	58
Dec.	14	Acree, O. A. C	Newton	68
··	27	Adamson, Edwards & Co	Ophelia	86
··	29	Allridge & Shelton	Brooksville	87
··	31	Allen, C. B	Ashland	95
1901.				
Jan.	7	Andrews, W. T	Gold Hill	133
··	11	Andrews & Co	Camp Hill	172
··	12	Alston, S. F	Tuscaloosa	174
··	12	Akin, J. C	Notasulga	178
··	15	Alston & Farrow	Wetumpka	184
··	15	Adkinson, D. I B	Florala	189
··	15	Atkins, V. B. & Co	Selma	193
··	15	~~Akin, J. C~~	Camp Hill	206
··	15	Agee, R. H. ~~& W. C~~	Selma	252
··	15	Ashepoo Fertilizer Co	~~Charleston, S. C~~	~~265~~
··	17	Atkinson & Atkinson	Jemison	319
··	17	Atkin & Allgood	Thornton	341
··	21	Albritton, E. S	Warrior	400
··	21	Ashhurst, J. V	Tallassee	416
··	22	Arnold, W. A	Ozark	424
··	23	Allen & Co., R. W	Lafayette	441
··	23	Atkins, L. C. & Co	Langston	445
··	25	Atkins, Jos. M	Brompton	467
Feb.	1	Adams, J. E	Welden	512
··	4	Arant, J. M. & Sons	Waverly	533
··	5	Abecrombie, A. J	Leeds	545
··	7	Atkins, B. C	Reform	561
··	8	Amos, G. H	Duck Springs	573
··	13	Agee, W. P	Perdue Hill	594
··	19	Allen, L. M. & Co	Phil Campbell	625
··	19	Abecrombie, J. H	Leeds	636
··	19	Anthony, W. L	Hurtsboro	637
··	20	Ash & Crandall	Birmingham	652
··	20	Alderhold, J. L	Piedmont	656
Mch.	16	Appling Mercantile Co	Oakman	750
··	19	Adams, J. G	Anniston	757

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of License.
1901.				
Mch.	26	Awbry, J. J	Mason, Ga	771
Apl.	4	Atkins & Owens	Heflin	785
..	22	Alford, J. C. & Son	Childersburg	803
1900				
Oct.	3	Bailey, W. E	Aster	11
..	11	Birmingham Fertilizer Co	Birmingham	26
Dec.	10	Brantley, T. K. & Ivie	Troy	58
..	10	Butler, Cole & Co	New Hope	61
..	13	Buford & Co	Hartford	67
..	22	Bank of Enterprise	Enterprise	81
1901				
Jan.	2	Benson Henderson & Co	Andalusia	101
..	4	Beeland, J. T. & Bro	Greenville	114
..	7	Brice, J. A	Oneonta	130
..	7	Brown, J. A	Kellyton	136
..	8	Bates, J. T	Plevna	138
..	8	Butler, F. T. & J. C	Paint Rock	146
..	14	Brannon & Henderson	Troy	199
..	15	Brown, W S	Birmingham	234
..	15	Bradley Fertilizer Co	Charleston, S. C	249
..	15	Bean & McMurry	Heflin	254
..	15	Beach, H. M. & Son	Columbia	258
..	16	Brown, J. W	Sylacauga	278
..	16	Brown, W. D	Gravella	292
..	17	Beale Bros	Luverne	314
..	17	Barnes, Jasper E	Dothan	317
..	17	Beason, J. L. & Co	Whitney	320
..	17	Boon, Alonzo	Camp Hill	334
..	17	Bullard, Bartow	Elba	342
..	17	Barfield Bros	Barfield	343
..	17	Bell, C. W. & Sons	Lineville	344
..	18	Blackburn, J. W. & McConnel	Fayette	349
..	18	Butler, C. H	Childersburg	351
..	18	Bullock, J. A	Shorter	364
..	19	Bellinger, W. C	Gadsden	375
..	19	Bodiford, W. H	Abbeville	380
..	21	Britt & Johnson	Wetumpka	388
..	21	Bryan, T. L. & Co	Ozark	395
..	21	Bains Bros	Cleveland	397
..	21	Burns & Beavers	Lincoln	398
..	21	Brake, J. L	Warrior	399
..	21	Barnett, W. W	Geneva	401
..	23	Beyer, F. & Son	Cullman	444
..	25	Brantzy, T. M	Kennedy	465
..	25	Baird, S. J	Guin	468
..	25	Bynum, W. H	Boaz	469
..	29	Blackwood, D. R	Cleveland	488
..	30	Butler, J. E	New Hope	497
..	30	Brodbeck & Zundel Bros	Point Clear	498
..	31	Boyett Bros & Rodgers	Andalusia	507

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of License.
1901.				
Jan.	28	Bear, Lewis & Co	Pensacola, Fla	481
..	28	Brawner & Brawner	Castlebury, Ala	482
..	28	Burt, R. A	Collinsville	483
Feb.	1	Bell J. J	Florala	515
..	2	Banks, T. C	Attalla	522
..	2	Burks & Coston	Brantley	526
..	4	Brundridge Banking Co	Brundridge	529
..	4	Bynum, T. D	Bynums	532
..	7	Bowdon, C. P	Gordon	555
..	7	Boreland, J. B. & Co	Pinckard	564
..	11	Burgess, J. L	Scottsboro	587
..	13	Blansitt Bros	Sulphur Springs	596
..	13	Brown & York	Boaz	606
..	13	Bell, W. R	Goddard	614
..	16	Barton, W. M	Lynn	623
..	16	Baits, G. J. & J. W	Toney	629
..	19	Black, Jas. A	Luverne	647
..	20	Bryant & Williams	Notasulga	653
..	25	Baccus, W. B. & Son	Baccus	670
M^ch.	5	Baker, D. W	Goodwater	683
..	5	Boazman, Tom	Marcoot	686
..	7	Byers, Mrs. Ada V	Ashville	697
..	11	Babcock, H. T	Troy	714
..	12	Blackburn, N. W. & Co	Leesburg	733
..	16	Braswell, M. L	Pleasant Gap	740
..	21	Brittain, J. C	Summit	761
..	24	Butler & Collier	Gurley	796
..	26	Banks & Owen	Hurtsboro	806
May	4	Banks, R. D	Jackson's Gap	809
1900.				
Oct.	3	Continental Fertilizer Co	Nashville, Tenn	7
..	31	Campbell & Wright, Jr	Roanoke, Ala	39
Nov.	20	Cowart, J. H. & Co	Goshen	55
Dec.	10	Cameron, Jas. A	Columbiana	63
..	12	Covington, J. I	Bertha	66
..	15	Cassels Bros	Gadsden	70
..	21	Cross, W. S	Pelham	78
..	29	Coley & Sandlin	Alexander City	92
1901.				
Jan.	5	Carlisle, M. W. & Bro	Roanoke	125
..	5	Crew, C. M	Goodwater	126
..	7	Cox, L. O	Boaz	127
..	9	Cullman Cotton Co	Cullman	149
..	11	Clark & Parker Bros	Searight	166
..	12	Crump, J. C. & Son	Sand Mountain	177
..	14	Copeland, J. S	Troy	200
..	15	Crumpton, W. E	Maplesville	216
..	15	Cawthon, W. C. W	Andalusia	224
..	15	Carter Co., The J. H	Cullman	[illegible]
..	15	Cleveland, M. L. & Co	Randolph	245
..	15	Cameron Bros	Notasulga	237

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of License.
1901.				
Jan.	15	Carney, W. M. & Co	Atmore	239
..	15	Cantelou, Lamar & Son	Wetumpka	262
..	16	Cross, Fred	Portersville	271
..	17	Crew, B. F	Goodwater	322
..	17	Carter, Jno. S	Haleyville	333
..	17	Cole, G. P	Loachapoka	339
..	17	Cornelius, H. M	Walnut Grove	347
..	19	Carroll, J. S.	Troy	371
..	19	Chapman & Co	Geneva	379
..	21	Crew, J. W	Elamville	389
..	21	Campbell & Wright	Tuskegee	391
..	21	Capps, D. W	Capps	405
..	21	Carroll & Watson	Watford	406
..	23	Cobb, H. C	Millbrook	431
..	23	Columbia Fertilizer Co	Columbia	432
..	23	Colquitt Bros	Luverne	434
..	23	Chadwick & Brice	Snead	435
..	23	Curry, W. W	Albertville	438
..	23	Carr, J. A.	Carrville	446
..	28	Collins, N. S	Collinsville	476
..	28	Collins, J. R	Bankston	480
Feb.	1	Chapman & Warren	Georgiana	509
..	1	Cosper, R. E.	Sterrett	517
..	4	Collins, H. D	Fayette	541
..	8	Coxwell, Jno. M	Perdue Hill	571
..	9	Carleton & Co	Dudleysville	582
..	13	Clarke & Harwell	LaGrange, Ga	589
..	16	Cope, A. M	Union Springs, Ala	627
..	20	Crutchen & Ward	Cuba	654
..	23	Cox, W. H	Springville	667
Mch.	5	Collins, The Co	Warrior	677
..	5	Costin, J. W. & Co	Luverne	692
..	9	Cartwright, R. N	Cartwright	704
..	11	Crew, R. A. & Son	Goodwater	717
..	12	Cooper, J. F	Fax	729
..	16	Clem, R. M	Fairmount	738
..	16	Coleman & McAlpin	York	744
..	16	Clements, N. B	Oregonia	747
..	30	Crump, H. C	Sedden	779
April	6	Cothran, T. E	Alexis	791
..	22	Crow Bros	Jacksonville	804
1900.				
Oct.	22	Davenport, N. S	Valley Head	32
Nov.	12	Dothan Guano Co	Dothan	48
1901.				
Jan.	4	Dawkins, W. T	Abbeville	109
..	8	Dean, J. J	Charlton	140
..	10	Davie, B	Clayton	161
..	10	Donaldson & Shaw	Haleyville	163

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Date of Issue.		Name.	P. O. Address.	No. of License.
1901				
Jan.	14	Dyer, W. C	Stanton	197
..	15	Dennis, J. A. & Co	Ansley	209
..	15	Dent, Geo. H	Eufaula	243
..	15	Dan, J. P	Milport	246
..	16	Dumas, O. & C. P	Arlington	294
..	16	Davis, W. C. & Co	Sand Mountain	298
..	16	Draper & Co	Oxford	308
..	17	Dailey, M. W	Avoca	338
..	18	Dorman, Jas. F	Carrville	350
Nov.	21	Davis, E. R	Rock Run Station	402
..	21	Darrow, E. J	Coats Bend	404
..	23	Duncan, E. P	Alexander City	440
..	24	Downey, J. W. & T. B. Chattin	Section	450
Feb.	4	Dyar, C. M. & L F	Reedbrake	536
..	5	Deramus, D. I	Verbena	546
..	6	Downs, J. B	Clanton	551
..	11	Dunn, A. M.	Elamville	588
..	13	Doughty, J	Fayette	610
..	19	Decatur Warehouse & Milling Co	Decatur	648
..	26	Davenport, E. T. & Co	Valley Head	671
Mch.	5	Dunlap, W. R	Wolf Creek	678
..	5	Davis, Marshall & Co	Mobile	695
..	12	Duncan. R. A	Dickson	727
..	16	Davis, Chas. S	Hurtsboro	748
Apl.	9	Dean, J. I	Red Level	789
1900				
Oct.	12	Elrod & Gibson	Collinsville	28
Dec.	28	Earle, Terrell & Co	Birmingham	88
1901				
Jan.	15	Emmett, L. S., Son & Co	Albertville	258
..	16	Edmonson, R. Q. & Bro	Eufaula	281
..	18	Espy, Jno. R.	Gordon	355
..	22	Ellis, J. M. & Son	Union Springs	430
..	28	Evens Bro's	Heflin	473
Feb.	1	Echols & Hargrove	Hartselle	519
..	5	Ellison, W L	Walnut Grove	543
..	7	Edwards, J. B	Talladega	554
..	19	Eubanks & Cheney	Piedmont	642
..	20	Edwards, R. D	Sylacauga	650
Mch.	16	Elliott, J. A & Son	Moundville	746
..	16	Evens, D. H	Hillion's Store	749
May	17	Elington, S. M	Munford	815
1900				
Oct.	3	Furman Farm Improvement Co	Atlanta &E't Pt.,Ga	5
Nov.	15	Farmers & Merchants Bank	Troy	50
Dec.	14	Foy, Cliff & Bro's	Abbeville	69
..	20	First Bank of Elba	Elba	76
1901				
Jan.	4	Folmar, W. B	Troy	111
..	4	Frazen & Olson	Thorsby	112

LICENSES—Continued.

Date of Issue.		Name.	P. O. Address.	No. of L[icense]
1901				
Jan.	4	Flynt, H. L	Guntersville	11
..	5	Folmer, Walden & Byrd	Enterprise	12
..	10	Farley, Jno. C	Opelika	16
..	14	Farmers Alliance Co-operative Co	Opelika	19
..	14	Farrow, T. L	Guntersville	20
..	15	Fuller, Foshee Mercantile Co	Brewton	22
..	15	Fuller, J. H. & Sons	Alexander City	25
..	19	Farnham, J. H	Evergreen	36
..	22	Fleming, W. L. & Son	Brundidge	42
..	28	Forrester, R. B	Cowarts	43
..	30	Fountain, H. B	Albertsville	50
Feb.	4	French, J. E	Brundidge	52
..	19	Flippo & Phillips	Bear Creek	64
..	23	Farrell, J. D	China Grove	66
Mch.	5	Fort Gaines Oil and Guano Co	Fort Gaines, Ga	67
..	12	Foust, V	Rosa	72
..	18	Feagin, T. K	Feagin	73
..	16	Fruitdale Lumber Co	Fruitdale	74
..	19	Frames, J. H	Slate	75
..	26	Farrin, A. J	Ohatchee	75
..	28	Fielder, J. B	Loachapoka	77
..	28	Fields, A. S	Fern Bank	77
1900				
Oct.	3	Goulding Fertilizer Co	Pensacola, Fla	
..	6	Georgia Chemical Works	Augusta, Ga	2
..	8	Grisham, J. M	Whitehead	2
Dec.	10	Gadsden Installment House	Gadsden	50
..	19	Gadsden Cotton Seed Oil Co	Gadsden	74
1901				
Jan.	3	Gulledge, F. A	Verbena	10
..	8	Goldthwaite, Robt	Montgomery	10
..	14	Guthrie Bros	Sulligent	17
..	15	Gary, Kennedy & Co	Selma	22
..	15	Griel Bro's & Co	Montgomery	241
..	15	Guin Bro's	Kennedy	24
..	16	Gilbert, R. F	Portersville	27
..	16	Grady, J. W	Stroud	28
..	16	Guntersville Dry Goods Co., The	Guntersville	30
..	16	Grant Bro's	Louisville	30
..	17	Gilliland, C. H. & Sons	Goodwater	32
..	17	Gray, J. B. & W. W. Gulledge	Ohatchie	33
..	19	Gunter, G. W	Brockton	38
..	21	Gunter & Ealum	Gantt	409
..	24	Green, Jas. F	Arthur	451
..	28	Green, Alex	Thomasville	486
..	39	Green & Mullins	Active	496
Feb.	2	Gallant, J. A	Gallant	525
..	4	Glenn Bro's	Branchville	534
..	7	Golden, B. F	Thaddeus	558
..	13	Graham, J. R	Boliver	590

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1901.				
Feb.	13	Gage. W. A. & Co	Town Creek	592
..	18	Graves & Burdine	Deposit	598
..	18	Grace, J. W	Elkmont	611
..	14	Gilbert, J. J. & Sons	Gold Mine	615
..	16	Gilbert, John R	Pinckneyville	630
..	22	Gilliland, M. E	Hill	659
..	22	Griffith, Asa	Hanceville	660
Mch.	5	Griffis & Son	Sedden	676
..	5	Gray, Wm	Dadeville	685
..	9	Griffith, G. F	Hokes Bluff	705
..	12	Guin, P. C	Covin	731
..	12	Gable & Clapp	Gum Springs	732
..	19	Gilbert, P. N	Coalville	758
..	30	Gammill, J. W	Camp Hill	775
Apl.	23	Gooday Bros	Daphne	799
May	4	Goldson Harper & Son	Brocton	808
..	4	Gray, W. C. & Co	Oxford	811
1900.				
Oct.	3	Home Mixture Guano Co	Columbus, Ga	9
..	11	Helm Bone Fertilizer Co	Birmingham	25
..	33	Howe & Co	Stevenson	34
..	31	Holman, H. C	Ozark	40
Nov.	15	Henderson, Fox	Troy	51
Dec.	10	Ham, P J. & Sons	Elba	60
..	19	Henderson, Rainer & Hill	Brantley	75
..	21	Howell, J. R. G	Dothan	77
..	22	Henderson, Holloway & Co	Enterprise	82
	31	Hester, R. B. & Son	Roanoke	93
..	31	Holly & Lindsay	Abbeville	94
1901.				
Jan.	1	Henderson, J. D. & Co	Searight	99
..	2	Hill, Jones & Co	Roanoke	102
..	3	Hill & Shaffey	Dadeville	106
..	4	Hilton, Bentley & Cosby	Brantley	113
..	4	Hatton, D. J. & Son	Wait	115
..	4	Howard, J. M	Albertville	168
..	4	Howle, T. A. & Co	Oxford	173
..	14	Herring, T. J	Midland City	194
..	16	Hilliard, W. L	Troy	198
..	14	Henderson, J. Robt	Fullerton	205
..	15	Henderson & Waters Bros	Brundridge	218
..	15	Howle Bros	Wetumpka	230
..	15	Hertzler & Anderson	Madison	231
..	15	Howison, Allen P	Randolph	266
..	16	Henderson, Chas	Troy	269
	16	Henry, S. W	Springville	272
..	16	Harrison, W. D. & Co	Ashford	295
..	16	Henderson, J. H	Cross Keys	300
..	16	Hartsell, J. C, & Son	Hartselle	310
..	17	Hooper, C. W. & Co	Selma	323

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Date of Issue.		Name.	P. O. Address.	No. of License.
1901.				
Jan.	17	Hughes & Bros	Flolala	329
..	18	Harwell, W. O	Opelika	354
..	19	Hixon, S. D. & D. A	Perote	387
..	21	Head, T. L	China Grove	408
..	21	Hughes, D. D	Labanon	414
..	21	Hooper, A. B	Alexander City	415
..	22	Haralson, J. B	Langston	416
..	22	Haynes, D. P. & Bro	Oxford	428
..	23	Hartsell, J. P	Hartselle	442
..	23	Hoffman & Graves	Waverly	443
..	23	Hixon Bros	Hixon	447
..	24	Haynes, Parker & Co	Lineville	448
..	24	Haight, J. H. & Son	Fruitdale	453
..	24	Hicks, W. W. & Co	Dadeville	455
..	25	Harrell, W. F	Bangor	460
..	29	Hodo, J. B	Millport	489
..	30	Hammond, M. W	Marl	493
..	30	Hood, J. M. & Son	Albertsville	501
..	31	Heard & Lee	Camp Hill	506
Feb.	1	Hamilton, M. D. & Co	Guin	514
..	1	Herrin & Oliver	Dadeville	531
..	4	Head & Warren	Gum Springs	547
..	6	Hicks & Heard	Camp Hill	548
..	6	Hodges, J. A	Ashville	570
..	6	Hightower, C. B	York Station	578
..	6	Haley Bros	Hayleyville	579
..	6	Hamilton, N. O	Ragland	581
..	6	Hood, Yielding & Co	Birmingham	584
..	6	Hood, Robt	Kymulga	602
..	6	Henderson & Black	Troy	604
..	6	Henderson, Alex. & Co	Troy	605
..	6	Hamilton, R. F	Coal City	617
..	6	Herston & Barnes	Garland	673
..	6	Hitchcock, J. G. & Son	James	690
..	6	Hearn & Wood	York	700
Mch.	8	Harris & Sherrod	Courtland	703
..	8	Harkins, Max & Clyde	Fayette	718
..	11	Hudson, F. N	Blountsville	741
..	16	Hargrove, J. H	Hartselle	760
..	21	Hendrix, S. T	Peterman	762
..	30	Hodges Mercantile Co	Ashville	780
Apl.	5	Hollinsworth & Co	Millin	787
..	10	Haynie, A. C	Hurtsboro	792
..	22	Hines & Son	Standing Rock	800
..	25	Hal[illegible] J. A	Pea Ridge	805
Dec	6	Ingram & Co	Anniston	64
Jan.	1[illegible]	Ivey, J. W	Rutledge	211
Feb	4	[illegible] & Frawick	Opelika	537
..	19	Ivey, C. [illegible]	Evergreen	638

LICENSES—Continued.

Date of Issue.	Name.	P. O. Address.	No. of License.
1900			
Oct. 23	Jones, J. B	Fayette	85
Dec. 29	Johnston, Geo. A	Clayton	91
1901			
Jan. 15	Jones, V. D	Troy	238
" 15	Johnson, W. A	Rutledge	256
" 18	Johnston, Thos. L. & Co	Gadsden	359
" 21	Jennings, B.	Tuskegee	390
" 21	Jordan, H R. & Son	Collinsville	392
" 22	Jackson, Jess H	Grand Bay	420
Feb. 1	Jemison, S. E	Sunny Side	511
" 2	Johnson, L. M	Alexander City	523
" 8	Johnson, J. J	Geneva	577
" 13	Jackson, Geo. W	Mount Hope	591
Mch. 5	Johnson, J. E	Chattanooga, Tenn.	694
Apl. 5	Jones, A. F	Talladega	786
1900			
Oct. 18	Killian, H. H	Branden	80
1901			
Jan. 11	King, H. S	Searight	167
" 11	Kelly & Segrist	Midland City	168
" 16	Kyser, Geo. W	Ripton	277
" 16	Kroell, Geo	Montevallo	279
" 16	King, F R. & Co	Leighton	312
" 19	King, Claude	Leighton	386
" 21	Klaus, J & Co	Huntsville	413
" 22	Kitchens, J. W. & Bro	Heflin	421
" 24	Kelly, D. E. & J. O	Jeff	457
" 28	Kelly, Walter	Normal	497
" 28	Killen Dry Goods Co., The.	Fort Payne	484
Feb. 6	Kennedy, J. A	Loop	552
Mch. 9	Kinney, P. H. & Co	Navvoo	705
Apl. 5	Keener, D. P	Keener	784
1900			
Oct. 3	Louisville Fertilizer Co	Louisville, Ky	14
Dec. 11	Long Bro's	Jasper	65
" 21	Long-Richardson Mercantile Co	Jasper	80
1901			
Jan. 2	Law, Edmons & Byrd	Enterprise	97
" 5	Lester & Co	Columbiana	123
" 7	Leach, R. R	Liberty	135
" 8	Land, J. G.	Cullman	145
" 9	Loeb, J. & Bro	Montgomery	147
" 12	Lauderdale, A. R	Goodwater	175
" 14	Lull & Lacy	Wetumpka	202
" 15	Lazinby, Reynolds & Co	Forest Home	212
" 15	Langston, J. N	Jemison	217
" 15	Little, Chas. E	Auburn	247
" 15	Law & Davis	Lincoln	261
" 16	Lidden, F. B. & Co	Gordon	284
" 16	Lane Bro's	Sylacauga	291

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Date of Issue.		Name.	P. O. Address.	No. of License.
1901				
Jan	18	Leath, Scott	Cullman	357
"	18	Leeman, E. D	Athens	365
"	19	Landers Bro's	Heflin	383
"	28	Long, T	Greenville	433
"	28	Latham, S. A. & Co	Montevallo	478
"	29	Livingston, Y. C	Notasulga	487
"	30	Long, C. W	Granger	495
Feb.	7	Lowery, W. W. & Co	Atmore	563
"	7	Long, W R	Lynn	565
"	13	Legg, Joel W	Elkmont	595
"	13	Lagney, H. W	Eden	607
"	13	Linn, W. W	Falkville	612
"	13	Logan, W. J. P	Benson	613
"	16	Laxon & McCord	New Market	621
"	19	Landham, J. R. & Co	Anniston	632
"	22	Lewis & Estes	Athens	661
Mch.	9	Lile, J. L	Trinity	707
"	18	Lumpkins, J. B. H	Jacksonville	755
"	30	Lowe, A. S	Hazel Green	781
Apl.	10	Lyon, R. L	Riley	794
"	10	Lee, W. A	Glen Allen	795
"	26	Lefils, W. F. & Son	Easonville	807
May	28	Lloyd, Ellison & Co	Creek Stand	812
1900				
Oct.	3	Marietta Guano Co	Atlanta, Ga	2
"	3	Mobile Phosphate Co	Mobile	10
"	3	Meridian Fertilizer Factory	Meridian	13
"	3	Montgomery Fertilizer Co	Montgomery	19
"	30	Marks & Gayle	Montgomery	36
Nov.	12	Malone & Sons	Dothan	47
Dec.	19	Meadows, Smith T. & Co	Opelika	73
"	31	Mullins, W. I	Clanton	96
1901				
Jan.	3	Manley, Hornsbey & Handley	Roanoke	107
"	7	Mills, J. B	Abbeville	129
"	7	Milner, Henry	Columbiana	131
"	8	Moon & Harris	Lineville	139
"	14	Macon, W. H	Wetumpka	183
"	14	Masterson, T. C	Arcola	204
"	15	Moody, J. W. & Son	Brompton	233
"	15	Middlebrook, J. Z	Elamville	250
"	16	Maxwell, C. R	Northport	287
"	16	Metcalf, P. M	Hartford	296
"	16	Miller, Lovelace & Co	Dadeville	306
"	17	Mizell & Bro	Ozark	316
"	17	Mayo, A. B	Talladega	329
"	17	Milligan, W. G	Heflin	345
"	17	Mahan, W. H. & Son	Randolph	348
"	19	Murphree, Joel D	Troy	370
"	19	Murphree, J. D Jr., Cashier	Troy	379

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Date of Issue.	Name.	P. O. Address.	No. of Licenses.
1901			
Jan. 21	Myers, H. J	Langston	396
" 30	Moog & Weil	Battles	500
Feb'y. 4	Murdock, E. H. & A. S	Coffee Springs	542
" 7	Moore, Chancey & Pepper	Phil Campbell	559
" 16	Mays & Winter	Waverly	625
" 28	Merritt & Adams	Geneva	666
Mch. 5	Melton & Co	Pine Apple	682
" 5	Mills, W. R & Sons	Pine Apple	688
" 7	Maroney, C. L. & Co	Montevallo	696
" 9	Miller & Sons	Oxford	708
" 11	Mathews, J. E	Flint	715
" 16	Moore, S.	Courtland	753
Feb. 7	Mayberry, W. C & Sons	Waverly	562
8	Moore, W. S	Perdue Hill	572
" 8	Montgomery Bros	Lincoln	575
" 8	Miller & Barnett	Berry	576
" 18	Mapes, M. A.	Phil Campbell	600
Jan. 4	McClung, F. M	Coats Bend	120
" 8	McEntine & Millard	Hanceville	144
" 9	McNaro & Pitman	Albertville	148
" 14	McKenzie, W. F	Greenville	193
" 15	McGehee, Driver & Co	LaFayette	227
" 15	McEntyre, Henderson & Adams	Ozark	240
" 16	McGowen, W. E	Cuba	302
" 16	McDonald, T. C	Luverne	305
" 17	McClusky & Co. and Boaz Gin Mill Co	Boaz	346
" 22	McMillan & Harrison	Mobile	413
" 25	McEntire Bros	Cullman	466
Feb'y. 4	McCallet, James E	Deposit	535
" 4	McCluney & Miller	Coats Bend	538
" 7	Mackentepe, J. W. & Son	Cullmaan	569
" 16	McWorter, A. J	Stricklin	624
" 20	McIntyre & Sellers	Ashford	655
Mch. 5	McEntyre, T. H. & Co	Coffee Springs	679
" 7	McCrackin & Baker	Berry Station	698
" 28	McQueen, J. S. & Co	Greenville	773
1900			
Oct. 3	N. O. Acid and Fertilizer Company	New Orleans, La	16
Nov. 8	Navassa Guano Co	Wilmington, N. C.	43
Dec 24	National Fertilizer Co	Nashville, Tenn	84
1901			
Jan. 8	Newman, Robert	Abbeville	103
May 15	Neighbors, J. A. & Co	Goodwater	264
" 9	Neighbors, T. L. & Bros	Goodwater	152
" 15	Newton, W. F	Dothan	221
" 16	Nichols, J. A	Childersburg	286
" 21	Nation & Pato	Liberty	407
Jan. 21	Noble, M	Avery	408
" 29	Northcutt, J. A	Winfield	491
Feb'y. 1	Newton, W. M	Bellville	513

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Date of Issue.	Name.	P. O. Address.	No. of Licenses.
1901.			
Feb'y. 7	Nolan Bros	Alexander City	556
" 16	Nelson, Mrs. A. B	Walnut Grove	622
" 16	Nixon, W. D	Merrellton	628
" 20	Neher, E. J	Holleywood	648
Mch. 12	Nettles, T. A	Kempville	725
" 15	Nicholson, L. S	Collinsville	736
" 25	Norwood & Co	Ft. Deposit	765
" 30	Nix, Thomas	Travis	778
1900			
Oct. 3	Old Dominion Guano Co	Atlanta, Ga	15
" 3	Opelika Chemical Co	Opelika	20
" 30	Ozark C. S. Oil Mill Fert. Co	Ozark	38
1901			
Jan. 14	Ober, G. & Sons Co	Baltimore, Md	185
" 16	Oakley, W. F	Columbia	290
" 17	Ogletree, T. W	Eastaboga	327
" 18	Overton, E. A	Huntsville	363
" 19	Ogden, F. & Sons	Sulligent	381
Jan. 2	Oldfield, John M	Hazel Green	410
Feb. 14	Oliver, J. M	Dadeville	618
Mch. 11	Overstreet, W. W	Greensboro	719
1900			
Nov. 2	Patrick, P. A	Florence	41
Dec. 29	Perryman, Bros	Heflin	90
1901			
May 2	Presswood, J. A	Andalusia	100
" 4	Pilcher, Geo. W	Dothan	110
" 5	Pinkard, E. M	Clanton	124
" 9	Pittman, A. J	Wehadkee	150
" 9	Pilcher, W. C	Dothan	154
" 10	Patton & Archibald	Foster	158
" 11	Phillips, J. R. & Co	Bear Creek	170
" 14	Pridley, W. G	Sulligent	180
" 14	Pinkston, J. C	Shorter	195
" 15	Planters and Merchants Bank	Ozark	220
" 15	Platt and Long	Kennedy	244
" 15	Phillips Bros	Oxford	260
" 15	Pacific Guano Co	Charleston, S. C	266
" 15	Patapsco Guano Co	Baltimore, Md	267
Jan. 16	Parish, T. R. & Bros	Clayton	275
" 16	Pope, J. F. & Co	Vincent	289
" 16	Parker, James M	Equality	297
" 16	Pearce, J. P, Son & Co	Carbon Hill	309
" 16	Pearson, H. W	Alexander City	311
" 17	Planters Warehouse and Commission Co	Eutaw	326
" 18	Patterson, M. F. & Son	Falkville	356
" 18	Pope, G. W. & Co	Luverne	367
" 19	Perkins, Jr., W. W. Estale	Springville	378
" 21	Phillips & Goddard	Clarence	393
" 21	Porter & Foster	Town Creek	412

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Date of Issue.		Name.	P. O. Address.	No. of License.
1901				
Jan.	25	Porter, C. J. & Co	Jacksonville	464
..	26	Perry, W. C	Seale	471
..	26	Pearce, Jim & Co	Guin	475
..	30	Pierce, W. S. & Co	Louisville	503
..	31	Pope, J. F	Wilsonville	504
.	31	Pearse, J. M	Pearce's Mill	508
Feb.	1	Prattville Mercantile Co	Prattville	521
..	8	Pride, W. G. & Bro	Madison	568
..	9	Pope, M. F	Fayetteville	580
..	8	Payne, J. M	New Market	597
..	8	Probst Bros	Fayette	608
..	16	Patterson, J. B	Mid	628
..	16	Pressly & Co	Springville	631
..	26	Peacock, S. D	Garland	672
Mch.	5	Pilley, R. L	Georgiana	681
..	5	Patterson Bros	Pine Apple	687
..	5	Porter & Stewart	Munford	689
..	8	Pridgen, J M	Key	702
..	9	Pruett & Pruett	Goodwater	711
..	12	Pully, C. H. & Co	Huntsville	723
..	16	Pitts, W. M	Union Springs	742
	26	Phillips, J. P. & Co	Ashville	766
Apl.	17	Penny, M F	Hoke's Bluff	797
May	8	Parker, C. C. & Co	Albertville	810
..	18	Pepper, W. J	Phil Campbell	814
1900				
Oct.	22	Read Phosphate Co	Nashville, Tenn	33
Nov.	8	Rasin-Monumental Co	Baltimore, Md	44
Dec.	8	Rome Guano Co	Rome, Ga	57
1901				
Jan.	2	Rainer Bros	Troy	96
..	4	Rogers, J. W	Burleson	116
..	7	Rhodes & Bro	Georgiana	126
..	7	Riddle, A J. & Son	Arab	134
..	7	Rouse, L. D	Wetumpka	137
..	9	Reynolds, H. C. & W. B	Centreville	151
..	9	Robertson & Floyd	Opelika	153
..	10	Rice & Russell	Arab	164
..	14	Riddle, D. H	Goodwater	181
..	15	Riddle, S. W. & Co	Gadsden	215
..	16	Rhodes Mill & Mercantile Co., The N. M.	Shell	299
..	17	Ramage, Jas. T	Brundidge	335
..	18	Reynolds Bros	Jemison	361
..	19	Russell, R A. & Co	Gaylesville	373
..	19	Reaves, Launders & Co	Heflin	384
..	21	Russell Bros	Attalla	394
..	22	Rainer, S. P	Union Springs	429
..	24	Roe, S. N	Elba	452
..	24	Reynolds, E. H	Notasulga	458
..	25	Riley, F. M	Riley	463

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1901				
Jan.	28	Read & Co	Edwardsville	472
..	29	Reynolds, J. F	Nottingham	490
..	30	Rigsby & Camp	Phil Campbell	494
..	30	Randall & Son	Daphne	499
Feb.	1	Robertson, Robt. C	Fayette	510
..	1	Ryan & Co	McGuinn	518
..	18	Rentz & Turner	Thomasville	593
..	19	Robertson, Jas. R. & Son	Cropwell	633
..	19	Roberts, G. W	Collinsville	645
..	20	Russell, W. W	Fort Payne	649
..	28	Ranschenburg, C. F	Spruce Pine	664
Mch.	8	Rodgers, T S,	Morris	701
..	9	Rice, C. E	North Port	713
..	11	Reyrolds, H. C & W. B	Blocton	716
..	11	Reynolds. Walker	Rendalia	724
..	12	Roberts, J. E	Pleasant Gap	739
..	16	Rosser & Johnson	Dadeville	745
..	21	Roberts, W. I	Fayette	759
..	22	Roy, J. D	Deatsville	763
..	26	Robbins & McGowan Co	Brewton	767
1900				
Oct.	3	Stumpe, J. M	Florence	1
..	8	Swift Fertilizer Works	Atlanta, Ga	12
..	3	Standard Guano & Chemical Mfg.Co	New Orleans, La	17
Dec.	10	Smith, R. H	Collinsville	62
..	15	Stewart, W. A	Dawson	71
..	17	Savannah Guano Co.	Savannah, Ga	72
..	21	Sanders, J. G. & John	Dothan	79
..	22	Stokes, R. E	Abbeville	83
..	28	Snead, J. H	Boaz	89
1901				
Jan.	3	Snead, Jas. E	Snead	105
..	4	Sellers & Orum	Montgomery	119
..	7	Schuessler & Co	Roanoke	132
..	8	Stiefelmeyer, C. A	Cullman	142
..	10	Snead, C. E. & Bro	Boaz	160
..	14	Smitherman, H. M	Goodwater	182
..	14	Smith Bros. & Co	Warrenten	186
..	14	Stiefelmeyer, C. A	Hanceville	187
..	14	Stewart, S. E	Hartselle	188
..	15	Stephens, S. B	Petrey	208
..	15	Schloss & Kahn	Montgomery	210
..	15	Sellers, W. R	Troy	223
..	15	Savage, Chas. B	Evergreeen	226
..	15	Sturkie & Duke	Gadsden	229
..	15	Shepherd, Z	Georgiana	242
..	15	Sanders, G. A. & Son	Luverne	257
..	16	Stewart, T. F	Spring Garden	288
..	16	Schiffman, S. & Co	Huntsville	301
..	16	Sibert, W. J	Gadsden	308

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1901				
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··	17	Simms & Bro	Blountsville, Ala	815
··	17	Spraggins, J. R	Hackleburg	818
··	17	Shorter, E. S. & Co	Eufaula	824
··	17	Shipp & Co	Albertville	828
··	17	Stanley Bros	Jasper	831
··	17	Scarborough, W. A. & Co	White Plains	832
··	17	Shellmet N. S	Welsh	840
··	18	Storey, The A. G. Mercantile Co	Talladega	858
··	18	Snodgrass, J. D	Scottsboro	860
··	18	Sanders & Son	Columbia	862
··	19	Smith, J. W	Cooper	877
··	19	Smith, M. S	Selma	885
··	22	Smith & Davis	Fort Payne	426
··	23	Schuessler Bros	LaFayette	436
··	23	Selman & Co	Albertville	437
··	24	Self, E	Selfville	454
··	24	Smith, G. H	Ealums	456
··	25	Sellers, C. W. & Sons	Inverness	459
··	26	Stark, W. E	Seale	470
··	26	Stokes, Sessions & Co	Ozark	485
Feb.	1	Sessions & Mizell	Enterprise	516
··	4	Strock, W. H	Verbena	527
··	5	Stephens, T. H. & H. B	Seaborn	544
··	6	Stonacher, F. W	Luttrell	549
··	7	Schwab Jonas Co	Birmingham	550
··	6	Smith, E S	Argo	552
··	7	Stringfellow, E. M	Reform	560
··	8	Shreve Bros	Andalusia	567
··	13	Smith, Fred	Steels Depot	601
··	19	Smith, M. L	Dadeville	634
··	19	Shaw, W. A	Winfield	641
··	19	Sellman, A. J	Albertville	644
··	22	Stewart, Formby & Co	Piedmont	657
··	22	Sampy, W. L	Gadsden	658
··	22	Sims, J F	Brompton	662
··	22	Stewart & Hazlewood	Eden	663
··	24	Stanford & Collins	Crews Depot	665
Mch.	12	Sellers, R. D. & Son	Omega	728
··	12	Smith, H. B	Yancey	730
··	14	Searight Mercantile Co	Searight	735
··	30	Smith Bros	Sylacauga	776
··	30	Stewart, T. O	Munford	777
Apr.	2	Scott, G. G	Mt. Pleasant	782
··	5	Stewart, B. M. & J. E	Spring Garden	788
··	6	Stone, J. A	Alexis	790
Feb.	17	Skelton, R. S	Scottsboro	798
May	8	Snow, P. H. & J. T. Mosely	Boaz	813
1900				
Oct.	5	Tennessee Chemical Co	Nashville, Tenn	6

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1900			
Oct.	5	Troy Fertilizer Co	Troy
"	18	Tallapoosa Oil Co	Alexander City
"	8	Thompson & Kelley	Normal
Nov.	2	Tennessee Valley Fertilizer Co	Florence
"	5	Trawick & Jernigan	Opelika
"	14	Talladega Fertilizer Co.	Talladega
Dec.	24	Tuscaloosa Cotton Seed Oil Co	Tuscaloosa
1901			
Jan.	10	Thomas Bros	Alexander City
"	11	Tucker, Willingham & Co	Lafayette
"	14	Talley, J. T	Roanoke
"	14	Thornton, E. L., Manager	Mountain Creek
"	15	Thornton, B. E	Gordo
"	15	Turnipseed, W. O	Oxford
"	16	Truss, Geo. M. & Co	Springville
"	18	Thomas, W. C. & Co	Gold Hill
"	19	Teague, S. F	Birmingham
"	25	Thomasville Mercantile Co	Thomasville
"	26	Thompson, W. C	Hartselle
Feb.	1	Thompson, W. C. & Co	Prattville
"	4	Talley, Dyer N	Trussville
"	7	Towers, W. W	Maple Grove
"	8	Thompson, C. W	Tuskegee
"	18	Tisdale, W. R	Andalusia
"	14	Tabor, Jno. T. & Co	Keener
"	19	Teague Bros	Ashville
"	20	Thomas & Barwick	Oneonta
Mch.	5	Terry, A. T. & Son	Forney
"	11	Taylor, G. W	Huckabee
"	26	Toney, Harris	Swancott
"	26	Trammell & Co	Roanoke
1900			
Nov.	26	Union Fertilizer Co	Atlanta, Ga
1901			
Feb.	13	Usry, O. E	Hebron, Ala
1900			
Oct.	8	Virginia and Carolina Chemical Co	Atlanta, Ga
"	11	Virginia and Carolina Chemical Co	Newnan, Ga
Nov.	5	Vandiver & Co., W. F	Montgomery
1901			
Jan.	15	Vandegrift, A. B. & Son	Birmingham
"	16	Virginia and Carolina Chemical Co	Charleston, S. C
"	16	Vaughn, W. B	Elkmont
"	16	Vinson Banking Co	Georgiana
1900			
Oct.	3	Winston, J H	Jenifer
Nov.	16	Winkler, A. G	Greenville
"	19	West & McMurry	Roanoke
1901			
Jan.	4	Wright, Henderson & Co	Elba

LICENSES—Continued.

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1901.				
Jan.	5	White & Awbrey	Roanoke	122
..	8	Wood, N. W	Collinsville	141
..	8	Wood, W. J.	Abbeville	148
..	9	Williams. T. B	Cullman	155
..	10	Wilhite, W. B	Hartselle	158
..	10	Webb, Jno. C.	Demopolis	159
..	11	Walker, Rushton & Co	Rutledge	165
..	21	Walker, J. E	Alexander City	178
..	14	Weathers, Swann & Co	Roanoke,	207
..	15	Warten, Henry	Athens	218
..	15	White & Edmonson	Troy	219
..	15	Woodward, J. B.	Talladega	232
..	15	Wilder, R. M	Brantley	248
..	15	Ward, W L & Son	Selma	263
..	16	Windham. W. C	Troy	268
..	16	Warnock & Sons	Oxford	276
..	16	Whaley. Monroe	Blountsville	283
..	16	Woolf, John P	Piedmont	285
..	17	Wright, A. R	Farill	321
..	17	White, J. B. & Co	Talladega	330
..	18	White & Spigener	Goodwater	352
..	18	Weil, M. W. & Co	Huntsville	366
..	19	Walker & Ashcraft	~~Kennedy~~	~~374~~
..	21	Willis, J. J. S	Mt. Andrew	411
..	22	Webb & Morgan	Langston	417
..	22	Whitehead. J. B.	Winfield	422
..	22	Watkins, F	Opelika	423
..	22	White, M. A	Attalla	427
..	28	Westmoreland, J. E. F	Florence	479
..	29	Walker, J. H	Wolf Creek	492
..	31	Williams. P	Lebannon	505
Feb.	2	Welden, R. G. & Co	Wilsonville	524
..	4	Wilder, A. C. & Co	Vincent	530
..	4	Welch & Co., Wm	Alexander City	540
..	8	Winn & Son	Clayton	574
..	9	Waite & Maddox	Easonville	583
..	9	Wood, R. R	Childersburg	585
..	9	Wise, G. W	Madison	586
..	13	Wilson & Co	Russelville	609
..	14	Walker, F. M	Dadeville	616
..	14	Williamson, F. F. & Son	Opelika	620
..	19	Walls, H. D.	Grant	639
..	23	Woodall, A, W	Springville	668
..	28	Wood & Hattemer	Fort Deposit	674
Mch.	5	Ward, H. B	Cuba	680
..	5	Windham & Ennis	Hillsboro	693
..	7	Wallace, S. H.	Klein	699
..	9	Williams, Pinkney	Lebanon	706
..	9	Walkley, D. W	Wetumpka	712

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Date of Issue.	Name.	P. O. Address.
1901.		
Mch. 11	Wilson, W. M. & Bro	Clanton
" 11	Walker, J. T. & J. B	Plevna
" 11	Wilson, J. C. & Son	Lincoln
" 11	Williams, J. S	Pansey
" 11	Winter, Loeb & Co	Montgomery
" 11	Waldrip, J. R	Hanover
" 11	White, J. W. Bros	Clayton
" 11	Windham & Co	Moulton
" 11	Wedgeworth, Walter E	Akron
" 11	Wedgeworth, Will M	Greenwood

FERTILIZER LAWS.

PROVISIONS REGULATING THE SALE OF FERTILIZERS.

378 (139). *Sale or exchange of commercial fertilizers; license required.*—Commercial fertilizers must not be sold or exchanged without a license from the commissioner authorizing the person making the sale or exchange to deal therein. All sales or exchanges made without such license are void.

See citations to section 386 (141).

379 (140). *License; fee; duration.*—On the payment of a fee of one dollar, the commissioner must issue license to any person or firm, or corporation, or association of persons, authorizing the sale or exchange of fertilizers during a season, expiring on the thirtieth day of September of each year.

380. *Evidence.*—The printed report of a commissioner or a certified copy of the record in his office showing the issuance of a license to sell or exchange commercial fertilizers, and to whom and when issued, is presumptive evidence of the fact that such license was issued to such person at such date. But this provision does not preclude the introduction of the license in evidence.

386 (141). *Dealer must attach tags, else sales or exchange void.*—Before selling or exchanging, or offering to sell or exchange fertilizers, the licensees must attach one of such tags to each bag, barrel or package containing two hundred pounds or any less number of pounds; two tags to each bag, barrel or package containing more than two hundred pounds and not more than four hundred pounds, and one additional tag for each additional two hundred pounds or fractional part thereof, contained in such bag, barrel or package; and a sale or exchange of fertilizers not so tagged is void.

A sale of commercial fertilizers, made in violation of statutory requirements, is void, and no recovery can be had for the price.—Campbell v. Segers, 81 Ala. 59; Steiner v. Ray, 84 Ala. 93; Clark's Cove Guano Co., v. Dowling, 85 Ala. 142; Merriam v. Knox, 99 Ala. 93; Brown v. Adair, 104 Ala. 652; Kirby v. Huntsville Fertilizer & Milling Co., 105 Ala. 529.

When contract of sale made in this State.—Johnson v. Hanover Nat. Bank, 88 Ala. 271; Hanover Nat. Bank v. Johnson, 90 Ala. 549; Brown v. Adair, 104 Ala. 652.

Residence of sellers and place of manufacture of goods are immaterial when delivery made in this State.—Merriman v. Knox, 99 Ala. 93; Brown v. Adair, 104 Ala. 652.

Tags must be attached at the time of the sale; if previously attached, and lost before the sale. others must be supplied, else the sale is void. Clark's Cove Guano Co. v. Dowling, 85 Ala.. 142; Kirby v. Huntsville F. & M. Co., 105 Ala., 529.

Action on commercial paper given for the price of fertilizers sold without compliance with statutory requirements cannot be maintained, even by a bona fide purchaser before maturity.—Hanover Nat. Bank v. Johnson, 90 Ala. 549.

When want of license pleaded, burden of proof on plaintiff.—Edisto Phosphate Co. v. Sanford, 112 Ala. 493.

387. *Including tag tax in price of fertilizer vitiates sale.*—Whenever any manufacturer, merchant or other person selling fertilizers shall, directly or indirectly, include such tag tax in the price of the fertilizer sold, such sale is void.

388. *Contracts for sale of fertilizers at fictitious prices; only real market value recoverable.*—In contracts for the sale of fertilizers in which an excessive or fictitious price is put upon such fertilizers with the stipulation that if such fertilizers are paid for on or before a certain date they may be paid for in a smaller sum than such excessive or fictitious price, or in cotton or other produce at an excessive or fictitious price, the difference between the excessive or fictitious price charged for the fertilizers and their real market value shall be held a penalty; and in all suits to enforce such contracts only the real market value of such fertilizers, with the interest thereon, shall be recovered.

38. *Parol evidence competent.*—Parol evidence is competent to show such market price, the situation of the parties and the consideration of such contracts, as in cases of usury, notwithstanding any writing in the premises.

390. (42). *Fertilizers to be submitted to commission.*—Before offering a fertilizer for sale or exchange, the person proposing to sell or exchange must submit to a commissioner a written or printed statement, setting forth—

1. The name and brand under which such fertilizer is to be sold or exchanged, the number of pounds contained in the bag, barrel or package, in which it is to be put upon the market, the name or names of the manufacturers, and the place of manufacturing.

2. A statement setting forth the amount of the named ingredients which they are willing to guarantee such fertilizers to contain: First, nitrogen; second, water soluble phosphoric acid; third, citrate soluble phosphoric acid; fourth, acid soluble phosphoric acid; fifth, potash; and such statement shall be held to constitute a guarantee to the purchaser that every package of such fertilizer contains not less than the amount of each ingredient set forth in the statement, and when such statement sets forth the maximum and minimum of any ingredient, the commercial value shall be estimated upon the minimum alone; but this shall not preclude the party from setting forth any other ingredients which the fertilizer may contain, which as well as the preceding, shall be embraced in the guarantee.

See citation to section 386 (141).

391 (143). *Fertilizers or chemicals for manufacturing to be branded.*—All fertilizers or chemicals for manufacturing or composting the same, offered for sale, exchange or distribution, must have branded upon, or attached to each bag, barrel or package, in such manner as the commissioner may by regulation establish, the true analysis of such fertilizers or chemicals, as claimed by the manufacturer, showing the percentage of valuable elements or ingredients such fertilizer or chemical contains, and its commercial value, calculated upon the standard value of the principal ingredients as set forth in the preceding section as priced by the commissioner of agriculture at the beginning of each season, and in every case the brand must specifically set forth the percentage contained in the fertilizer section, in the terms of that section.

392 (144) *Fertilizers; what not included in term.*—The term "fertilizer," or "commercial fertilizer," used in this chapter, does not include common lime, land plaster, cotton seed meal, ashes, or common salt not in combination.

393 (145). *Chemist of department.*—The professor of chemistry of the Agricultural and Mechanical College is the official chemist of the department. On the application of the commissioner he must analyze and certify the analysis of all fertilizers, samples of which are furnished him; and, at the request of the commissioner, if he can without conflict with his duties as professor, must attend conventions of agricultural chemists, make reports of such matters as he may deem of interest to the department, and render such other services in the line of his profession as the commissioner may require.

394 (146). *Compensation of Chemist.*—The chemist is entitled to

his necessary travelling expenses while on duty assigned to him by the commissioner, payable from the funds of the department as provided in the next article.

395 (147). *Copy of official analysis evidence.*—The copy of the official analysis of any fertilizer or chemical, under the seal of the department of agriculture, shall be admissable as evidence in any of the courts of the State. on the trial of any issue involving the merits of such fertilizer or chemical.

CRIMINAL LAWS.

SECTION 4153.—*Dealing in fertilizers without submitting statement to 'ommissioner.*—Any person who manufactures or exchanges, sells or ffers for sale or exchange, any fertilizer without first submitting the tatement required by law to the Commissioner of Agriculture, must, n conviction, be fined not more than five hundred dollars for each ffense.

SEC. 4154. *Selling fertilizers without attaching proper tags* —Any peron who sells, exchanges or offers for sale or exchange, any bag, ackage or barrel of fertilizer which has not been tagged as provided y law, must on conviction, be fined not less than fifty dollars for each ffense.

SEC. 4155. *Using more than once, and counterfeiting tags.*—Any peron who counterfeits the tags prepared by the Commissioner of Agriulture, knowingly, or who uses a counterfeit of such tag, or who ses a second time a genuine tag, or who uses the tag of a former eason, must, on convictio.. be fine one hundred dollars.

SEC 4156 *Making false certificate of analysis of fertilizers* —Any hemist, who wilfully makes a false certificate of the analysis, or of he ingredients of any fertilizer intended or offered for sale or exhange, must on convictian, be imprisoned in the penitentiary for iot less than two, nor more than five years.

SEC. 4157. *Dealing in commercial fertilizers without license.*—Any erson who sells or exchanges fertilizers without having obtained a icense from the Commissioner of Agriculture, as provided by law, nust, on conviction, be fined not less than one hundred dollars for ach offense.

SEC. 4158. *Fraud in manufacture, sale or exchange fertilizer.*—Any erson who commits a fraud in the manufacture, sale or exchange of ny fertilizer, or of the ingredients of a fertilizer, must, on convicion, be fined not less than one hundred dolars for each offense.

Special attention is called to the following rules for branding bags or the season of 1901-2.

The words "GUARANTEED ANALYSIS" must be in letters not less han one inch in height. The word "ALABAMA" must be in letters

(all capitals) not less than one and one-half (1½) inches, and the balance of the guarantee, including the commercial value, must be in letters and figures not less than three quarters (¾) of an inch in height.

When the minimum and maximum guarantee is gixen, the commercial value must be calculated *upon the minimum alone.*

In computing the value of the commercial fertilizers the laws of Alabama only recognize the following ingredients: Nitrogen, Water Soluble, Phosphoric Acid, Citrate Soluble, Phosphoric Acid and Potash.

In making your calculations to determine the commercial value, you will confine yourself to the foregoing ingredients and to the following values:

Water Soluble Phosphoric Acid 5 cents per pound.
Citrate Soluble Phosphoric Acid 5 cents per pound.
Nitrogen........................16 cents per pound.
Potash (K 2 O).... ....6½ cents per pound.

I would respectfully call your attention to the fact that it is the opinion of our Attorney-General that every Fertilizer Dealer or Manufacturer who sells goods in this State must obtain a license before offering their goods for sale. Failure to obtain such license not only makes the sale void and the debt non-collectible, but subjects the seller to a fine of one hundred dollars for each sale made. The license fee is only one dollar. The fertilizer season runs from October to October, and I would suggest that you send for your license at the *beginning* of the season.

ALL COMMERCIAL FERTILIZERS MUST BE ANALYZED BY THE STATE CHEMIST.

AN ACT

To Amend Subdivision 18, Section 147 of the Code.

Section 1. *Be it enacted by the General Assembly of Alabama,* That subdivision eighteen of section one hundred and thirty-seven of the Code be amended so as to read as follows: It shall be the duty of the Commissioner of Agriculture to obtain samples of each and every brand of fertilizers sold and exchanged, or offered for sale or exchange, in this State, for each season in which such fertilizers are offered for sale, and cause such samples to be analyzed by the

State Chemist; and make publication of such analysis not later than August 1st of each year; *Provided*, that the provisions of this act shall not take effect until after September 1, 1891.

HOW SAMPLES SHALL BE DRAWN.

Special attention is called to the following rules for sending samples of Fertilizers to have analyzed. Farmers and others sending fertilizers for analysis must observe the following directions:

In order to secure a representative sample of fertilizers to be analyzed, a small amount of material should be removed from the interior of of a number of sacks and the samples thus obtained should be thoroughly mixed in order to secure uniformity. At least 6 or 8 ozs. of the material are then placed in a wide mouth glass bottle, which is then sealed and properly labeled. In the case of ton lots of fertilizers, at least every third sack should be sampled in order to secure a final sample, which will approximately represent the whole lot.

The sample should be drawn in the presence of two reliable witnesses and the label attached to the bottle should contain the name of the manufacturer and the name of the goods as taken from the bag in which the fertilizer is sold.

The sample is shipped to Commissioner of Agriculture, at Montgomery, Ala., with transportation prepaid, to be forwarded to the State Chemist at Auburn, Ala.

TO FERTILIZER MANUFACTURERS AND DEALERS.

In accordance with the provisions of Bulletin 11, page 105, no sample of fertilizers for official analysis will be received by this department until further notice, from manufacturers direct, except in the case of manufacturers within the State, who are licensed dealers and sell direct to consumers.

Such manufacturers can supply samples for analysis under the same terms as dealers, provided such samples are taken from large lots of goods as manufactured for the trade; and provided, further, that only one representative sample of each brand shall be submitted

for analysis by any given manufacturer, said samples being forwarded for analysis not earlier than December 1st.

Samples of the various brands offered for sale in this State will be obtained chiefly from dealers and consumers, and only from manufacturers when specially requested by this department, and such samples should be taken from goods as actually in stock after commencement of the fertilizer season.

Manufacturers who desire to secure analysis of samples drawn and forwarded by themselves, can have such analysis made at a moderate cost by forwarding samples direct to the State Chemist at Auburn, Ala.

R. R. POOLE,
Commissioner of Agriculture.

BULLETIN No. 116. SEPTEMBER, 1901.

ALABAMA.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Texas or Acclimation Fever.

By C. A CARY.

MONTGOMERY, ALA.
BROWN PRINTING CO., PRINTERS & BINDERS.
1901.

The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

NOTICE.

Bulletin No. 115 treats of the chemical analysis of commercial fertilizers made by the Chemist for the State Department of Agriculture. Since the bulletin is issued by the Department in large number and generally distributed among the farmers of Alabama, the Experiment Station has printed a limited edition for its own use, and copies will only be sent to the Station Libraries and the Directors of the Stations and a few other parties who are keeping files of the Bulletins for binding. But Bulletin 115 will be sent to any person applying for it until the issue is exhausted.

P. H. MELL, *Director.*

CONTENTS.

TEXAS OR ACCLIMATION FEVER,

By C. A. Cary.

INTRODUCTION.

The cattle breeding industry of the South has been held in check by the fact that Northern-bred and imported cattle could not be brought into the South without running great and unprofitable risks. In fact, the danger of losing such cattle was so great as to prevent or prohibit bringing fresh and imported strains of breeding animals into the infected regions of the South. As a result of this natural barrier, few beef-bred cattle came to improve the scrub stock or to improve the animals that had a tinge of Jersey blood in them. Possibly Jersey blood is more widely scattered among the native scrub cattle of the South than that of any other breed. Consequently, with a well-bred Jersey bull to head a herd, one could soon develop a respectable and profitable herd of grade Jerseys by using such a bull upon selected native Southern-bred cows. But none of the native Southern cattle have beef tendencies. Most of them do not mature until six or seven years old, and when mature they are too small for profitable beef animals—especially for shipping to distant markets. Beef animals must mature before they are three years old or they are not profitable.

The necessity for animal industry, especially cattle raising—is fast dawning upon the farmer of the South. It leads to diversified farming; it decreases the demand for commercial fertilizers by supplying larger quantities of manurial fertilizers that can be made upon the farm

and are far better than commercial fertilizers, because they are cheaper, and more permanently improve soil, both in mechanical condition and in available plant food. Feeding animals upon the farm and saving the liquid and solid manures gives the farmer a double use of the feed stuffs produced on the farm; because the manurial products contain from 60 to 90 per cent. of all the fertilizing materials that were found in the feeds that were fed the animals. For example: Cotton seed hulls and cotton seed meal lose but very little of their value as fertilizers by feeding them to cattle, providing the the liquid and solid manures coming from the animal are properly saved and utilized. The cattle industry does not mean that we shall not raise cotton, but that we can raise as much or more cotton than we do now upon less acreage and with less work and less expense for fertilizers.

During the past three years more beef-bred animals have been brought into the State of Alabama than during any previous time in its history. Unfortunately, some of them have been lost by acclimation or Texas fever; but the larger number of them have been saved by careful handling. Methods of acclimating or immunizing Northern-bred or foreign-bred cattle have been developed so that the dangers of acclimation have been reduced to the minimum—so that it is no longer unprofitable to bring into the South highly-bred breeding animals.

The chief object of this bulletin is to describe the methods of immunizing susceptible cattle to Texas fever, and give the records that have been made at this station and others by using the improved methods of immunizing Northern and foreign-bred cattle.

WHAT IS TEXAS FEVER?

In various parts of the country this disease is known by different names; it has been called Texas fever, acclimating fever, Southern fever, tick fever, Spanish fever, red water, hæmaturia, black water, murrain, dry murrain, yellow murrain, bloody murrain, hollow-horn and hollow-tail.

Texas fever is caused by a very small animal parasite (*Pyrosoma bigeminum,* Smith) which was discovered by Theobald Smith in 1889. Its chief place of living is in the red blood cells of cattle. In some condition it lives in the cattle tick and is carried from immune cattle or cattle sick with Texas fever, to non-immune or susceptible cattle by the tick. In this transmission of the microparasite from the diseased to the healthy animals, it passes through two generations of ticks. The female tick abstracts blood from its host; falls to the ground, deposits a large number of eggs that hatch in 14 to 45 days, and the young seed ticks get upon susceptible cattle and inoculate them. In many cases the fever appears in the cattle about the time the young ticks molt the second time; then the young ticks are about one-eighth of an inch long, and the careless observer may declare there are no ticks on the animal sick with Texas fever. It may be here stated that this micro-parasite has two hosts (cattle and ticks of two generations) and possibly can not live anywhere outside these two hosts. At least its existence in other hosts or places have not been discovered. In some respects it resembles the malerial parasite of man, but its stages of development, are not as well known as those of the malerial miscro-parasite. Yet some things are known of its form and life history in the red blood cells of cattle, and in the plasma of the blood. In mild cases of

Texas fever the micro-parasite appears as a single rou body in the red cell near the preriphery or the out border. Sometimes there may be two of these rou bodies in a single red cell of the blood. Occasional the small round bodies may appear singly or in pairs the plasma of the blood. In severe cases that usual occur in hot weather and when the temperature of t animal is high, there may be two spindle or pear-shap bodies in one red cell of the blood. According to Smit 5 to 50 per cent. of the red cells of the blood may conta these micro-parasites—the number of red cells infect will vary with the type (mild or acute) of the feve The number of red cells infected will also vary with t different organs from which the boold is taken for mic scopic examination. Blood from the capillaries of t liver, heart-muscle, and kidneys, contain from 20 to per cent. of infected red blood cells; while the blo from the capillaries of skeletal or voluntary muscl and the skin may contain very few (10 per cent. or les infected red blood cells.

Fresh or dried smears of blood may be examin under the microscope. For fresh smears collect a sma amount of blood with platinum loop; place it in the ce ter of a clean cover glass; drop the cover glass, blo side down, upon a clean slide and surround the cov glass with vaseline or paraffine; the mount is now rea for examination under the microscope. In makin dried smears, take two clean square cover glasses; pla a small drop of blood (picked up with the platinum loo on one of the clean squares a little to one side of t center, and with another clean square spread the dropl of blood over the lower cover glass by attempting scrape off the droplet with one edge of the upper cov glass, holding the upper one in the right hand inclin at an angle of about 20 degrees, with the lower one th

is held between the thumb and finger of the left hand. Dry the smears immediately after making them, and place them in the hot air oven, keeping them there for one and one-half to two hours, at a temperature 110 to 120 degrees C. Stain the smears with Lœffler's alkaline methyl blue from one to one and one-half minutes; wash in water and dip for an instant into a one-third per cent. acetic acid solution to remove excess of diffuse stain in the red blood cells; wash in water and mount in water or dry and mount in xyol balsam. Examine with a high power objective. (Smith's method.)

The **CHANGES** that **OCCUR IN THE BLOOD** are very characteristic in a case of Texas fever. Red blood cells in great numbers are destroyed by the micro-parasite. This is determined by actual count of the red blood cells in a definite quantity of blood; the test being made before, during and after or following the fever. In healthy old cattle the average number of red blood cells in a cubic millimeter is about 6,000,000. In healthy young calves the average number of red cells per cmm. may be as high as 8,000,000. In healthy mature or middle-aged cattle the average number may be about 7,000,000 per cmm. In acute cases of Texas fever the number of red cells in the blood may be reduced 2,000,000 or less per cmm. In mild cases of Texas fever the number of red cells will vary between 3,000,000 and 5,000,000 per cmm.

As associated with, or as a result of the great loss of red blood cells (anæmia) the red cells will vary in size and shape; some are very much larger than normal red blood cells and when stained with Lœffler's alkaline methyl-blue, become diffusely stained, and some of them contain very small granules. These large red cells are found in some forms of anæmia in man, and are called megalocytes.

The **UNITED STATES GOVERNMENT** has **ESTABLISHED** a **QUARANTINE LINE** which is fixed for the regulation of inter-state trade in cattle, so that Southern tick-infested cattle cannot be taken into non-tick-infested States (excep for immediate slaughter) during the warm seasons when pastures and susceptible cattle may become infected with ticks, and the latter inoculated with the micro-parasite of Texas fever. All the States, or parts of States, south of this line are in the tick-infested region, and all north of it are in the tick-free region. This line starts at the Atlantic Ocean, near the southern boundary of Virginia, runs westward, leaving nearly all of North Carolina, all of Georgia, Alabama, Mississippi, Louisiana, and Texas, part of Tennessee, Arkansas, Indian Territory, New Mexico, Arizona, and the southern part of California south of the Governmental quarantine line, in the tick-infested part of the United States.

This quarantine line and the fact that all Northern-bred cattle shipped into the South have Texas fever, have led many people to believe that Texas fever occurs only in Northern-bred cattle, and never in the native cattle of the South. But it has been proven in some cases, beyond doubt, that calves are not born immune to Texas fever even though their dams are immune. In truth, it is very probable that all cattle are born susceptible to Texas fever, and only acquire immunity after birth, by having one or more attacks of the fever. The micro-parasite in the blood of the dam can not pass into the fœtus in the uterus because the blood in the circulation of the mother does not pass directly into the circulation of the fœtus. The serum of the blood of the mother passes through membranes into the circulation of the fœtus and it is very probable that the micro-parasite does not pass through these membranes. Moreover, blood serum contains very few of the micro-parasites.

The calves that are born of immune cows and live in tick-infested lots or pastures, acquire immunity while young, by having such a mild attack of the fever that it is not observed. Possibly complete immunity is only acquired by two or more mild attacks that appear as the succeeding broods of ticks inoculate them.

Some of the calves born of immune cows escape tick infestation, and consequently escape inoculation. When full grown, or several years old, they may be taken into a tick-infested pasture or the ticks may be brought to them by introducing new cattle into the herd; then they may die of Texas fever. Many farms in Alabama are tick-free; many town lots are tick-free; parts of many farms and pastures are tick-free; consequently cattle that are bred and raised in such tick-free places are susceptible to Texas fever. Tick-free lots, pastures and farms are so made by keeping all cattle off them for one or more years, by rotation of crops and pastures, by burning the grass, by killing all the ticks on the home cattle, by stock law all the year round, and by introducing no new cattle without first completely ridding them of ticks. Ticks do not travel any great distance (a few feet only), except when upon their host; by themselves, ticks will rarely, if ever, cross a road 60 feet wide. Hence a tick-infested and tick-free farm may be very near each other and remain in that condition, providing cattle and horses are not permitted to go from one farm to the other, except when these farm animals are free of ticks. Records of losses in Alabama of native, Southern-bred cattle, from Texas fever have been reported to me every year for several years, and I have records of Texas fever occurring in Alabama-bred cattle in every season of the year. Of course the severe and fatal cases occur mostly in hot portions of the year, while most cases that occur in winter are mild. One or two illustra-

tions may bring out some of the above-mentioned conditions. A certain dairyman had kept his cattle and farm free of ticks for several years. He bought some new cattle, which were infested with ticks, and placed them in his herd. In due time his home-raised cows began to die with what he called "red water," which was Texas fever. Another man sold his entire herd of cattle that had been kept free of ticks; these cattle were moved just a few miles, and in a short time many of them died of Texas fever. Parties who buy calves or feeders from various farms in a neighborhood, beat or county, nearly always lose several some time after the calves or feeders have been brought together in the new feeding pens or pastures.

It might be well to state here that Hunt of Australia claims that some cattle ticks do not possess the micro-parasite of Texas fever—especially in a virulent form. This might explain some of the outbreaks of Texas fever among Southern-bred cattle in herds that are collected from many different farms or pastures. But so far as I know, all ticks of this species in the United States that have been tested, have been able to transmit the micro-parasite; and no positive facts have been discovered that show that the micro-parasite will vary in its virulency. Hence we must regard all ticks of this species as carriers of the Texas fever micro-parasite.

THE SOUTHERN CATTLE TICK (*Boophilus bovis*, Riley), is said to be a native of Northern Africa, and reached the Southern States by way of Spain, South America, Central America and Mexico. The life history of this tick, as discovered by Cooper Curtice, is described as follows:

The large female tick (the one so easily observed on cattle) drops to the ground when filled with blood from

its host; hides in some secluded place; lays or deposits from 1,500 to 3,000 eggs, and then dies. The incubation period, or time required for the eggs to hatch, will vary from 14 to 45 days; the length of time depends upon varying conditions of temperature and moisture. Warm weather and a little moisture shortens the period of incubation; cool weather or heavy rains prevent or retard hatching of the tick's eggs and destroy many young ticks. The small ticks fresh from the eggs are six-legged, and very lively, collecting in bunches, not unlike in appearance a mass of chicken mites. They are called "seed ticks" because they look like a small seed or because they are said to be the seed of the tick. They crawl or climb upon grass, weeds or any object near the place of hatching. Cattle passing through the grass or weeds will become infested with "seed ticks," which soon attach themselves by their mouth parts to the skin of their host. In 12 to 15 days the "seed tick" molts ("sheds its skin") and then possesses eight legs (4 pair) instead of six. A second molting occurs in from four to six days after the first, and following this second molting, the female tick very soon becomes larger than the male; the male possesses pointed shoulders, and never gets much larger after the second molting. The female engorges itself with blood from its host, and thus develops into the large, plump, fat tick that can be so easily observed upon infested cattle, and when mature drops to the ground and dies laying eggs. Thus the round of life is completed.

COULD ALABAMA OR THE ENTIRE SOUTH EXTERMINATE THIS SPECIES OF TICKS?

According to some authorities tick extermination is possible. One farm, one beat, one county can be made tick-free. Why not an entire State? If every cattle

owner in Alabama would voluntarily (or by compulsion) fight for the extermination of the tick it might be accomplished in two years. But extermination would now be next to impossible in the free-range counties of Alabama. It could be much more easily accomplished in stock law counties where the cattle are not permitted to run at large during the entire year. Every cattle owner being required to keep his cattle confined to his own pastures or definite limits could, by use of dips or washes, destroy the ticks on his cattle, horses and mules. He could also change his pasture from one part of his farm to another, at least once a year, or as often as he applies some dip or wash to the cattle to kill the ticks. The best time to get rid of the ticks on the cattle is in the winter when there are very few ticks. Once getting the cattle entirely free of ticks, they could then be put in a pasture where no cattle had been for one year or more. Following this the cattle must be inspected closely once every week, and if ticks should appear again kill them with dips and washes. Three applications of a tick-destroying dip or wash should be made; the second application should be given about ten days after the first, and the third about ten days after the second. The cattle are then ready to go into the tick-free pasture. If the herd is large it would be best to construct a dipping tank large enough to immerse one animal at a time. The tank might be wholly or partly sunk into the ground, having a pen and approaching chute, and a draining platform near the exit chute. The Bureau of Animal Industry at Washington, and Dr. Francis of College Station, Texas, have used large dipping tanks, and by applying to either of them by letter, plans and methods of constructing such tanks might be secured. Beaumont oil floating on warm water in the tank could be used to destroy ticks. It is cheap, and

could be applied full strength. Cotton seed oil or kerosene oil emulsion can be used, but they are more expensive than Beaumont oil. Where a farmer has only a few cattle the Beaumont oil could be applied with cotton lint or rags by putting each animal in a brake or chute and going over the animal thoroughly with the oil.

All new animals entering the herd must be made tick-free before being turned into the pasture with the herd.

What would be gained by having Alabama or the entire South free of ticks?

The most important advantage would be free and unrestricted cattle trade with the North, and all of Europe at all seasons of the year. You could then bring into the South cattle from the North at any season of the year without danger of loss from Texas fever. If Alabama or any Southern State were to produce "feeders" or "stockers" they could be shipped directly to the corn belt States at any season, and not be hampered by a quarantine extending from March or April until November or December. In short, the entire train of troubles coming from Texas or Southern cattle fever would be wiped out. All of this would be most desirable if all the tick-infested States would line up and completely exterminate the tick. But if one county or beat should exterminate the ticks within its borders (unless it be adjacent to the Government quarantine line), it would be in a great deal of trouble by its isolation. Unless adjacent to the quarantine line it could not ship its cattle out only at such times as could the tick-infested counties. Moreover, breeders in the tick-infested counties could not buy cattle in the tick-free county because such cattle are as susceptible to Texas fever as the Northern-bred cattle. Cattle from tick-infested counties could not be taken into a tick-free county without keep-

ing them in quarantine until they are made tick-free by dipping, etc.

The question of extermination of the tick resolves itself into this: It is a good thing for counties of townships contiguous to the Government quarantine line to make a fight to exterminate the tick and have the quarantine line moved South of them. But to commence in the center of a tick-infested State would only lead to trouble by increasing the number of outbreaks of Texas fever or by completely shutting off tick-free places from cattle trade with surrounding territory. I would not advise local tick extermination in Alabama except to get small pastures or places for acclimation purposes, and such places are not absolutely necessary for the new methods of acclimating Northern or foreign-bred cattle. Now this does not mean that any cattle owner should permit his cattle to become literally covered with ticks, but instead every cattle owner can keep off the excessive number of ticks and yet have a sufficient number of ticks to keep his cattle immune and to permit the calves to acquire immunity. No doubt excessive tick infestation retards the growth and development of beef cattle, and also the milk-producing capacity of the milch cow.

HOW TO RECOGNIZE AND DISTINGUISH TEXAS FEVER IN THE LIVING ANIMAL.

1. Learn the history of the diseased cattle. Were they bred and raised in a tick-infested or a tick-free region? Were new ticky cattle brought into the herd, or were the sick cattle put into a new pasture where ticks are present, either upon cattle or in the pasture? Look carefully for the small ticks upon the sick cattle. It takes an inexperienced person some time to find the small, young ticks. In some cases the ticks may have

been entirely or partially removed by use of oils or drugs or dips, but not until after the ticks had inoculated the animal.

2. The temperature of a tick-inoculated animal may rise before any other symptoms are observed. In mild cases the temperature will range between 103 and 105; in severe cases it may vary from 105 to 108 degrees Fah. The temperature may remain above normal a few days then drop to normal (102) for a few days. In chronic cases there may be variable or regular periods of alternate rising and falling of the sick animal's temperature. (See Admiral's temperature record in Table No. II.)

3. In mild cases the appetite is capricious or changeable. The sick animal may refuse feed at one time, and at another eat quite or nearly a normal or full feed. In acute or severe cases the appetite is entirely or almost completely lost; the sick animal may nibble at this or that feed, but will eat very little. Rumination is suspended (does not chew the cud) in all severe cases, during the high fever period, and some times until convalescence begins; this would lead some persons to claim that the animal was sick from "loss of cud."

4. At first or during the high fever period, the bowels are inactive. Loss of appetite, ceasing to ruminate and inactivity of the bowels indicate that digestion is suspended. The inactivity of the bowels may be indirectly a result of loss of red blood cells, a result of the high fever, or it may be due to congestion and sometimes inflammation of smaller or larger areas of mucous membrane lining the fourth or true stomach and of the intestines. Sometimes upon post mortem examination the mucous membrane of the fourth stomach and of intestines are found eroded or ulcerated—the membrane in small spots or patches has sloughed off. No doubt that the bowels are paralyzed, and no amount of heavy

purgatives will move them in that condition. Very probably many cases are killed by frequent doses of heavy purgatives, when small oleaginous (raw linseed oil) laxatives should be given to soothe the inflamed areas. Fermentation may be kept down by giving dram doses of creolin in one-half pint of water three or four times per day. When the animal's condition changes for the better, or begins to improve, the bowels may then become freely active; but in no case should the active bowels be checked; this will be corrected as the animal improves.

5. The respirations may be slightly accelerated, but in acute cases they are very rapid, running as high as 30 to 60 per minute. The rapid respirations are short or shallow, and in some cases are accompanied by a cough, and sometimes by groaning or grunting sounds.

6. The pulse in acute cases is rapid and as the number of red blood cells decrease, the pulse grows weaker. The weakness of heart and blood vessels and general muscular weakness cause the patient to lie down much of the time. When it attempts to walk the gait is wabbling, staggering, unsteady equilibrium. Sometimes the sick animal stands with depressed head and arched back.

7. The kidneys are usually quite active. Large quantities of urine are passed. In mild cases the urine is darker than usual and in severe cases the urine may be blood red (port wine color). This excess of color is the coloring matter from the broken-down red cells of the blood, and it is excreted from the body largely by the kidneys. The red colored urine does not contain blood, yet it leads many to call the disease "bloody murrain" or "red water." Remember that all acute cases or fatal cases do not pass red urine, but out of a number of sick animals in a herd some of the severe cases will pass red urine.

8. In some cases the eyelids become swollen so much that the animal can hardly open the lids sufficiently wide to see. Many cases are accompanied by a more or less prominent swelling under throat or root of the tongue, between the branches of the lower jaw.

As a rule the sick animal becomes separated from the rest of the herd; if weather is warm it seeks the shade, stands with arched back and shrunken abdomen, or lies down from weakness. In cool weather, or during the winter season, many cases perish largely from exposure to cold nights and cold rains.

EXAMINATION AFTER DEATH may help one in making an accurate decision in regard to the disease causing the death of the animal. Post mortem conditions are sometimes quite characteristic and constant; yet in some instances some of the common characteristics may be absent or not sufficiently marked as to be recognized. The condition of the carcass as to flesh will vary with the length of time the animal was sick, and the type or severity of the disease. As a rule a few days of high fever that suspends all digestive action will lead to rapid emaciation. In cutting through the skin notice that there is very little blood in it or the tissue just under the skin, and the small amount of blood in the skin is pale, and does not readily coagulate. After opening the abdominal cavity, examine the liver, the spleen, the kidneys, the bladder, the stomachs, and the intestines. If the animal died in one to three days after becoming sick the liver may be very large—engorged with blood and bile, giving it a rather dark brown color; but if the animal lived a number of days after becoming sick the liver will be engorged with bile and will have a deep yellowish tinge; this yellow color is very prominent upon a cut surface of the liver. The gall bladder is usually

excessively distended with thick flaky bile. The bile is said to be thicker and more flaky in cases that were sick several days before dying than it is in cases that die in a short time after becoming affected.

The spleen or "melt" is generally much larger than it is in the healthy animal; it may be three or four times as large as a normal, healthy one. It is darker than a normal one, and when cut open its bluish-black contents slowly flow out. There are some genuine cases of Texas fever in which the spleen is not very much enlarged or changed in color and structure.

The mucous membrane lining the fourth stomach and intestines may be inflamed or eroded in spots or patches; cut them open and wash away the contents so that the red, inflamed or ulcerated condition may be distinctly observed. In some cases the contents of the fourth stomach and of the intestines in places may be tinged with blood; if the intestinal contents are hard and firm they may be surrounded by a gelatinous material or exudate that is in places tinged with blood.

In severe cases when the animal dies early in the course of the disease, the kidneys may be enlarged and they may have a uniform brownish red color throughout their entire structure. Cover glass smears made with blood taken from the kidneys will show that a very large per cent. of the red blood cells contain the micro-parasite. The bladder will usually contain more or less dark brown or red colored urine. The color is produced by the hæmoglobin that is held in solution in the urine and comes from the disintegrated red cells of the blood. The urine also contains albumen.

The white membranes or tissues of the body—such as the serous and mucous membranes, the connective tissue under the skin, etc.—may become tinged with yellow very like the jaundice yellow in man. This is most

prominent or marked in chronic cases or cases of long duration.

The heart, according to Smith, has the right ventricle "distended with blood, fluid or clotted, according to the time elapsing between death and the examination. The left ventricle is usually firmly contracted and may contain a small quantity of fluid or clotted blood." The small extravasations of blood under the epicardium and endocardium are quite constant; they are most numerous on the outside and inside of the left ventricle.

WHAT IS IMMUNITY TO TEXAS FEVER?

IMMUNITY means that an animal is not susceptible to Texas fever. It is now believed that an animal can acquire immunity only by having the disease—one or more attacks. One severe attack of the fever or two or more mild attacks usually insure a safe immunity.

Immunity will last as long as the life of the animal, if said animal becomes infested with ticks one or more times each year of its life. But my observation of the disease, as it occurs in native Alabama-bred cattle, leads me to believe that immunity can be lost in two or three years by keeping the animal free of all ticks. I am confident that loss of immunity in this way explains the occasional outbreak of Texas fever in herds that have been kept free of ticks for two or more years, and then letting the cattle become infested with ticks.

METHODS OF PRODUCING IMMUNITY TO TEXAS FEVER.

The natural method is the one in which the ticks do the inoculating. Four different forms of tick inoculations have been tried. In many instances Northern-bred cattle were brought into the South, turned out with the herd; permitted or forced to "rough it," and survive or

perish with slight or excessive tick inoculation and poor care. Fifty to ninety per cent. of Northern-bred and imported cattle so treated died—a mortality too great to be profitable. A modified form of this careless way has been employed by many with much more favorable results. The susceptible animals are kept by themselves in barns, pastures and lots separated from native Southern cattle; at the same time a few ticks are allowed to get on the cattle, but excessive tick infestation is prevented. In a majority of such animals tick-inoculation occurs gradually. One summer in the South under such conditions has usually produced immunity. However, losses by this means are too great to recommend it when better means can be obtained.

Dr. Connoway of the Missouri Experiment Station and Dr. Francis of the Texas Experiment Station, have tried to control tick inoculation by placing a definite number of young seed ticks upon the suscpetible animals at different times. Collect full grown female ticks from Southern cattle and put them in a fruit jar or some vessel having a little moist earth at the bottom; this jar is then placed in an incubator or in the kitchen near a warm chimney or stove; in 15 to 20 days the female ticks will have deposited their eggs and the eggs will have hatched into a mass of lively seed ticks. About 25 of these seed ticks are placed upon each susceptible animal (best time in late fall or in winter) and they will inoculate each animal so that in the course of 10 to 30 days the fever will appear. When the animals recover from the mild attack of the fever (say in 40 to 50 days) a larger number (about 100) of incubator seed ticks are put upon each animal; this should produce a second attack of fever. When the cattle recover from it they are immune and ready for the pasture. At no time in this treatment should the cattle want for good feed and pro

tection from cold nights and rains. Some losses occur by this method, and it is a little more inconvenient and uncertain than either of the two methods that will be mentioned following this.

The fourth modified form of tick inoculation is the **one where sucking calves, 2 to 4 months old, are brought into the South in the fall or winter or early spring,** and allowed to take milk from a Southern-bred cow or are fed fresh sweet milk from a Southern cow. While young and during the time before it is weaned, put a few seed ticks upon the calf or permit them to get upon it in small numbers. Natural tick inoculation will then occur when the calf is best able to resist severe fever and to recover from it. It is possible that the milk of a Southern-bred immune cow may have some immunizing power, but I doubt it. I think the milk of a non-immune cow would be as effective because it keeps the calf in the best of condition to resist, and to recover from, the fever or attack of the micro-parasites upon the red blood cells. It is a well-known fact that young calves or cattle do not have Texas fever in as severe a form as do older or mature cattle. All competent observers or investigators of Texas fever have noted that fact. According to Hunt of Australia, (who produced by inoculation the fever in calves born of immune cows), immunity is not inherited. It is very probable that all Southern-bred calves do not inherit immunity, but acquire it after birth by tick inoculation. No doubt that the vast majority of Southern-bred calves have the fever in such a mild form that it is not appreciable. This partial immunity of calves to the fever may be explained by the fact that young animals have a greater number of red blood cells per cubic millimeter than do older animals, and can carry on the functions of the blood better in case of loss of red blood cells. Also, the power of reproducing red

blood cells is greater in the young than in the ol
animals. This may be due to the fact that there i
relatively greater quantity of red marrow in the you
animals, and this red marrow tends to reproduce
blood cells nearly as fast as they are destroyed by
micro-parasite. The general vigor of a young ani
may add to its resisting and recuperating power. M
over, it is well-known that young animals exhibit grea
power of repairing wounds and recovering from alm
any disease than older ones. Broken bones unite quic
and better in young animals than in mature ones.
Dr. Francis remarks, this method of immunizing su
ing calves is a good and safe way for farmers who
a few animals; but where many animals are wanted
a large ranch it is cheapest to use the defibrinated bl
method. One drawback to immunizing calves is t
the owner must wait one or two years before the cal
develop into breeding animals; it means loss of ti
but is a safe method.

The Defebrinated Blood Method of producing
munity to Texas fever in cattle was originated or
covered in Australia. It has been most extensively
ployed i nthis country by Dr. Connoway of the Misso
Experiment Station, and Dr. Francis of the Texas
periment Station. It has been tested by the Bureau
Animal Industry at Washington, D. C., and by the Lou
iana, the Mississippi and the Alabama Experiment S
tions.

Brefly speaking, it consists in inoculating a susce
ble or non-immune animal with blood that is fres
drawn from an immune animal and defebrinated.
animal from which the blood is derived should be
least two years old, and Southern-bred, and known
have had ticks upon it some time during the second su

mer of its life. A Northern-bred animal, that has acquired immunity by having had an attack of Texas fever within one year, may also be used as a source of blood for inoculation. After securing the animal the following instruments and articles should be prepared for the inoculation:

A sterilized hypodermic syringe, one or two sterilized scalpels or sharp knives, one or two sterilized aspirating needles with an inside diameter of 1 to 2 millimeters; a clean sterilized beaker or wide-mouth bottle, containing a small glass rod, and the bottle or beaker should be plugged with aseptic absorbent cotton; one pair of scissors, a 2 per cent. solution of creolin, and sterilized cotton or sponge, and sterilized distilled water. The water may be sterilized by boiling one hour.

Any or all of the above named articles, except the creolin solution and water, may be sterilized by placing them in a vessel of cold water, and then heating the water until it boils for one hour.

The animal from which the blood is to be drawn may be secured by using a cattle nose-leader or by casting it with ropes, hobbles, etc. Clip the hair very close over a space 3 to 6 inches long and 2 inches wide along the jugular forrow on either side of the neck (just over the jugular vein). Wash the clipped skin with soap and water; then with the creolin solution and then with distilled water. Now cord the neck of the animal as the neck of a horse is corded just before it is to be bled. When the neck is corded the jugular vein stands out prominently. Now the aspirating needle, with its point inclined toward the head, is pushed into the jugular vein and the blood that escapes through the hollow needle is caught in the sterilized breaker or wide-mouth bottle, and stirred slowly with the glass rod, being careful to

hold the cotton plug over the mouth of the breaker or bottle while stirring. As the fibrin collects in clots on the glass rod, it may be lifted out, and by a quick jerk of the rod the clot is dislodged from the rod and the rod is then returned to the breaker or bottle, and the blood is stirred until no more fibrin collects on the glass rod. In the breaker or bottle will remain nearly all of the red blood cells floating in the blood serum and some of these red blood cells will contain the micro-parasites that cause Texas fever. This deferinated blood should be kept warm (above 90 degrees Fah.) and when the susceptible animals are ready for inoculation, the defebrinated blood may be drawn into the warm hypodermic syringe and 1 cc injected under the skin of each susceptible animal. Remember that it is essential that the defibrinated blood should be kept warm and that the inoculations should be made as soon as possible after the defirinated blood is prepared, because it may become cool, or contaminated with septic or pus germs. It is best to have the cattle that are to be inoculated confined by halter or chains or stanchions in stalls. I should not advise the use of defibrinated blood that is over an hour old.

In about six to ten days after the inoculation the temperature of the inoculated animals will rise, ranging between 103 and 106 degrees Fah. The fever may continue from 3 to 15 or more days; then fall to normal (102); a secondary fever usually begins about the thirtieth day after the inoculation and may continue for several days. According to Pound, Francis and Connoway the primary inoculation fever appears in 6 to 10 days, and the secondary inoculation fever appears about the thirtieth day after the inoculation. The primary inoculation fever, as a rule, is more regular or will occur with greater regularity than the secondary inoculation

fever. In many cases the primary inoculation fever will be constant and regular, thereafter the temperature may rise and fall irregularly. In rare instances there may be a low continuous fever covering 20 to 40 days. Again there may occur but one fever period and that occur 20 to 30 days after the inoculation. As a rule, it requires from 40 to 50 days to pass through the inoculation fever periods. After recovery from the first inoculation, a second one is given to each animal. In case the first inoculation does not produce a fever running up to 105, it is always best to give a second inoculation and increase the dose of defibrinated blood; if 1 cc was employed in the first inoculation, use 2 cc of defibrinated blood in the second inoculation. As a rule, the second inoculation produces fever periods as in the first inoculation, but the fever is milder than it was following the first inoculation.

Inoculations to produce immunity to Texas fever should be made in the South sometime between Nov. 1st and the following March 1st, and never during hot weather. During the early spring or during the winter, immediately after the cattle have recovered from the inoculation fever, permit a few ticks to get on them. And when the hot weather of June, July, August and September comes, keep off the excess of ticks by applying once per week over places where ticks are most frequently found on the animals, crude Beaumont oil, or a 20 per cent. kerosene oil emulsion.

Immune animals are injured to some extent by supporting an excessive number of ticks.

In looking for accurate results from a large number of inoculations I wrote Dr. Francis of the Texas Experiment Station, and he kindly gave me the valuable facts which you may see in his letter published below.

Notice that out of 1,500 animals inoculated by him
per cent. were lost by inoculation fever and less than
per cent. by exposure to tick inoculation after recove
from defibrinated blood inoculation. Remember th
the vast majority of the cattle inoculated by him we
placed in large pastures on ranches where little or
attempt was made to keep off ticks; and that in ma
previous instances Northern-bred cattle under like co
ditions had a mortality as high as 50 to 90 per cent.

College Station, August 5, 1901.

Dr. C. A. Cary, Auburn, Ala.

Dear Doctor—I have your letter of the 2nd
regard to our experiments with Texas fever. I am p
paring a bulletin on the subject now and hope to have
off within six weeks. I have inoculated about 1,5
calves. These run all the way from a few months old
two years of age. I cannot tell you without sever
hours' work just how many of each age. I may sa
however, that the best age is about one year old. T
best time of the year is any time from November
March.

We consider one cubic centimeter as a standard do
We use all the way from one-half of one cc to two
but one cc is a standard dose. We take the blood dire
from the jugular vein of any Texas-raised animal th
is in good health. We usually take something that
two or three years old, so as to avoid the transmissi
of tuberculosis.

As a general rule, we make two inoculations. I thin
however, that one is enough, but we use two merely to
sure of an infection. If the time between inoculati
and exposure to ticks is several months, I favor two i
oculations.

I think that all our calves born in Texas are susceptible to fever, but pass through it while they are still young. I have seen some of our calves with the acute fever and passing red urine that were born and raised here. If they be raised in a pen, say in town, the death rate is pretty high among them, but those that are raised out in pastures the death rate is very low, and the attacks escapes ordinary observation.

The mortality from inoculation fever is about 3½ per cent. Dr. Conoway has written me the exact number that he has done, and the mortality. It is essentially the same as ours, but I hardly feel at liberty to give you his data. He will certainly supply you with it if you write him. I am yours very truly,

M. Francis.

P. S.—To make a general statement will say that we now save about 90 per cent. of all Northern cattle brought into this country. M. F.

TABLE I—Temperature Records of Registered Northern-Bred Cattle, Inoculated with Defibrinated Blood.

DATE.	Admiral.		Baroness		Champion		Gazelle.		Clemantina.		Charley.	
1899.—1900.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
Dec. 26	....	100.6	....	102.6	....	103.0	....	102.6	....	101.6	....	102.6
Dec. 27	102.0	101.4	102.2	100.8	100.0	102.2	100.4	102.0	102.0	101.6	100.4	100.4
Dec. 28	104.4	101.8	100.4	101.6	100.8	102.0	100.2	101.6	100.0	101.6	100.6	102.4
Dec. 39	101.6	102.2	101.2	102.2	101.4	102.8	101.6	102.6	101.4	101.2	100.8	102.8
Dec. 30	101.8	101.4	101.4	102.6	101.8	102.2	101.8	102.2	101.4	101.8	101.6	102.2
Dec. 31	101.8	101.8	101.8	101.2	101.2	102.2	101.8	101.8	101.4	101.4	102.0	102.2
Jan. 1	101.8	102.0	101.8	102.8	102.2	102.4	101.8	102.2	101.4	101.4	103.2	101.6
Jan. 2	102.0	101.6	101.8	103.0	101.8	102.6	101.2	102.6	101.0	102.0	102.2	102.4
Jan. 3	102.4	102.0	102.4	102.6	102.8	102.6	101.4	102.4	101.0	101.6	102.4	102.2
Jan. 4	101.4	102.0	103.4	103.0	101.4	102.8	101.6	102.4	101.4	101.4	100.8	102.4
Jan. 5	102.2	102.0	104.2	103.6	102.2	103.6	101.4	102.4	100.4	101.4	102.0	102.2
Jan. 6	101.4	101.4	104.8	104.6	102.0	102.4	101.6	103.0	101.2	102.0	101.8	102.0
Jan. 7	101.4	102.0	104.2	104.2	102.0	103.8	103.8	104.6	100.8	101.0	101.8	102.0
Jan. 8	102.0	101.8	103.0	104.8	102.6	102.2	103.2	103.4	101.4	101.8	101.8	102.0
Jan. 9	101.6	102.8	103.6	104.8	102.6	103.0	101.4	103.2	101.2	101.6	102.0	102.2
Jan. 10	101.8	101.6	103.8	105.0	102.5	103.2	104.0	104.2	101.2	102.4	101.8	102.6
Jan. 11	102.2	102.4	104.8	104.0	104.2	104.0	104.4	104.2	102.0	102.2	102.2	102.8
Jan. 12	101.3	101.6	102.4	103.2	101.8	101.8	103.4	104.8	101.8	102.2	101.0	101.4
Jan. 13	101.6	101.8	103.0	104.0	101.6	102.6	104.0	105.4	102.0	101.8	102.0	102.0
Jan. 14	101.6	101.8	103.2	104.6	102.0	102.1	104.6	104.3	101.2	102.0	100.8	101.6
Jan. 15	101.4	101.8	103.6	104.4	102.0	103.4	103.4	103.0	101.6	101.8	101.8	102.3
Jan. 16	101.6	102.8	104.1	105.2	102.0	103.4	102.2	102.6	101.4	101.8	101.4	101.8
Jan. 17	101.4	101.2	103.6	104.8	102.8	103.2	102.4	102.4	102.0	101.6	101.2	102.6
Jan. 18	102.8	103.4	104.6	105.4	102.3	103.0	102.8	103.2	101.0	101.4	102.2	102.2
Jan. 19	102.0	102.0	103.6	103.6	103.0	103.8	102.2	103.6	101.0	101.6	101.5	103.0
Jan. 20	102.0	102.4	103.8	105.0	101.8	101.4	103.0	104.4	101.4	101.6	102.2	101.8
Jan. 21	101.2	102.0	103.0	104.2	102.2	103.2	104.0	104.2	100.2	101.0	101.6	102.2
Jan. 22	101.6	103.1	105.2	105.4	102.2	102.9	103.6	104.2	101.2	101.4	102.2	103.2
Jan. 23	102.0	102.0	102.2	103.4	101.8	103.2	103.4	103.8	101.0	102.4	103.0	103.8

Jan. 24	101.6	103.2	102.6	104.0	102.0	102.4	102.8	103.2	101.0	102.2	102.6	103.4
Jan. 25	103.4	103.2	102.8	103.4	102.8	104.2	102.6	102.2	101.0	102.6	102.8	103.0
Jan. 26	102.2	103.2	102.6	103.0	103.0	104.2	102.0	102.2	101.4	102.0	103.6	103.6
Jan. 27	104.0	104.4	102.2	102.8	103.0	106.0	101.8	101.4	102.0	101.8	103.0	103.8
Jan. 28	102.0	104.0	102.2	103.2	104.4	106.0	101.4	101.6	101.6	102.0	103.0	103.0
Jan. 29	103.4	104.8	103.2	103.4	103.6	106.0	101.6	102.2	102.2	102.2	102.2	102.8
Jan. 30	103.0	103.6	103.6	103.6	104.2	105.2	101.4	102.6	101.6	102.8	102.6	103.2
Jan. 31	103.0	103.4	102.8	102.4	105.0	105.6	102.4	102.6	101.2	102.8	102.6	103.0
Feb. 1	104.0	104.6	103.0	103.6	105.6	105.6	103.4	103.0	102.8	104.2	102.0	102.0
Feb. 2	102.6	103.6	102.8	103.6	105.2	105.8	103.0	103.4	102.6	105.0	102.0	102.0
Feb. 3	102.8	103.8	103.0	103.0	103.4	105.8	102.0	101.4	102.0	105.6	101.6	101.8
Feb. 4	102.6	102.6	102.8	103.0	105.0	105.2	101.8	102.2	101.6	104.4	101.4	102.2
Feb. 5	101.2	102.0	103.2	103.4	104.6	104.6	102.0	102.0	102.6	105.0	101.2	101.0
Feb. 6	102.8	102.0	102.6	103.0	105.6	105.8	101.6	102.0	101.4	103.0	102.2	102.0
Feb. 7	102.2	102.0	103.0	102.2	104.4	103.0	102.4	103.0	102.6	103.4	102.4	101.6
Feb. 8	102.0	102.0	103.0	102.6	102.4	102.0	102.2	102.6	102.4	103.2	102.0	101.8
Feb. 9	101.2	101.0	102.6	102.6	101.0	102.2	102.0	102.4	102.0	102.0	100.6	101.4
Feb. 10	101.4	101.8	103.0	102.6	102.4	101.8	102.4	102.6	102.0	102.2	102.0	101.6
Feb. 11	102.0	101.4	103.2	102.8	102.0	102.8	102.4	102.4	102.2	102.0	102.0	101.8
Feb. 12	102.0	101.6	103.4	103.4	104.0	101.8	102.0	102.2	101.6	102.4	102.4	101.4
Feb. 13	102.0	101.8	102.6	102.4	102.4	103.0	101.8	102.4	101.6	102.0	101.4	101.6
Feb. 14	101.0	102.0	102.0	102.0	101.8	103.4	102.6	102.0	101.4	101.6	102.2	102.6
Feb. 15	101.6	101.6	102.4	102.4	102.0	103.0	101.8	102.4	102.0	102.0	102.2	101.8
Feb. 16	101.2	102.0	102.4	102.8	101.8	102.4	102.0	102.4	101.2	102.0	101.8	102.8
Feb. 17	101.8	101.4	103.0	103.2	101.8	101.4	101.8	102.4	101.6	102.0	102.6	101.0
Feb. 18	100.8	101.4	103.4	103.6	101.4	102.4	102.4	102.6	101.8	102.4	102.0	102.4
Feb. 19	101.2	101.6	103.4	103.6	101.4	103.0	102.6	102.6	100.4	101.4	101.4	101.8
Feb. 20	101.8	101.4	102.8	103.4	102.4	102.4	101.4	101.4	100.8	102.0	102.0	102.0
Feb. 21	102.0	101.6	102.2	102.4	102.2	102.6	102.2	102.0	102.0	102.0	102.2	101.8
Feb. 22	101.2	101.6	102.2	102.2	101.8	101.8	101.4	100.6	100.8	101.4	101.2	102.2
Feb. 23	101.2	101.6	101.8	102.6	102.2	103.0	101.4	101.8	101.0	101.4	101.0	102.0
Feb. 24	101.4	101.8	101.8	103.0	102.0	101.8	102.0	102.2	101.4	101.8	101.8	102.0
Feb. 25	101.4	101.6	101.6	102.6	102.0	102.6	101.8	101.4	102.0	101.2	101.2	102.4

TABLE I.—Continued.

DATE.	Admiral		Baroness.		Champion.		Gazelle		Clementina		Charley	
1899.—1900	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M	P. M.
Feb. 26	100.8	104.0	102.0	102.0	102.0	102.4	100.4	102.4	100.8	101.6	101.6	101.6
Feb. 27	101.4	103.4	102.0	105.2	101.4	102.8	101.8	101.6	102.0	102.4	101.8	101.6
Feb. 28	101.0	101.4	102.0	102.0	102.2	102.6	101.2	101.2	101.0	101.0	101.4	101.0
March 1	101.4	102.6	102.2	102.8	101.6	102.2	101.4	101.0	101.2	102.4	101.8	101.6
March 2	101.0	102.0	104.4	103.8	102.8	103.2	101.2	101.4	100.8	101.0	101.4	102.0
March 3	102.0	103.6	103.6	105.4	101.2	104.6	101.2	102.0	101.8	101.4	101.6	102.4
March 4	102.0	102.0	101.0	102.0	101.2	102.4	102.0	102.0	102.0	101.8	101.0	102.0
March 5	101.0	102.0	102.0	102.2	102.4	102.2	101.6	102.0	100.8	101.4	102.0	102.0
March 6	101.0	101.2	101.6	102.0	103.0	102.6	101.4	102.2	101.2	102.0	101.6	102.0
March 7	101.4	101.4	101.8	102.0	102.0	102.0	101.4	101.6	101.4	101.6	101.6	101.0
March 8	101.4	101.0	102.4	101.6	102.4	101.8	101.8	101.2	101.6	101.4	101.4	101.0
March 9	102.0	102.4	102.4	103.6	101.6	103.4	102.0	102.0	102.0	101.6	101.6	102.2
March 10	101.0	102.0	102.8	102.8	102.0	102.8	101.2	102.0	101.0	101.8	102.0	101.4
March 11	101.0	102.0	102.2	102.6	101.6	105.0	101.6	102.8	101.4	102.0	101.8	103.8
March 12	101.0	102.6	102.0	103.2	102.0	104.4	102.2	101.8	101.4	101.6	101.8	103.0
March 13	101.0	102.0	104.0	104.4	101.8	103.6	101.8	102.0	101.6	102.0	101.4	102.4
March 14	101.2	101.8	102.4	103.0	103.0	103.4	102.2	101.6	101.4	101.2	101.6	102.4
March 15	101.4	101.0	102.0	102.0	103.0	102.4	101.2	101.4	101.4	101.4	102.4	101.4
March 16	101.0	101.8	102.4	102.4	102.2	103.0	101.4	102.0	101.4	102.0	101.2	102.0
March 17	102.0	102.0	101.8	102.4	102.2	102.2	100.8	101.8	101.4	102.0	100.8	101.8
March 18	100.4	101.8	101.4	102.6	101.6	102.0	101.0	102.0	100.8	101.4	100.6	101.8
March 19	101.0	101.6	102.2	102.2	101.0	102.8	101.2	102.0	101.2	101.2	100.6	101.8
March 20	101.2	102.2	102.8	104.0	101.6	102.2	101.2	102.4	101.6	101.6	101.0	102.0
March 21	101.0	102.0	102.8	102.0	101.8	101.6	102.0	102.0	101.2	101.6	102.0	102.0
March 22	103.0	101.6	102.4	103.0	101.4	102.2	101.2	102.0	101.2	102.2	102.0	102.0
March 23	101.0	101.0	102.4	103.0	101.0	102.2	101.0	101.2	101.4	101.8	101.4	100.6
March 24	101.0	101.6	102.6	102.6	101.0	102.0	101.8	102.0	102.0	102.4	101.0	102.0
March 25	101.2	101.2	102.8	102.2	102.6	102.0	102.0	101.4	101.6	101.6	102.0	102.4
March 26	101.4	101.8	102.0	102.2	102.0	102.6	101.6	102.2	101.6	102.0	102.0	101.6

March 27	100.6	101.5	101.8	103.2	102.0	102.2	101.6	102.0	101.4	103.0	101.8	102.5
March 28	100.8	101.4	101.4	102.6	102.2	102.4	102.0	102.2	101.8	102.0	101.8	102.0
March 29	101.0	101.6	101.6	102.4	102.0	102.4	101.4	102.4	101.2	102.6	101.8	101.8
March 30	101.4	101.8	101.2	102.4	101.6	102.8	101.4	102.2	102.0	102.6	102.0	102.2
March 31	101.6	101.6	101.0	102.8	102.0	102.8	101.8	102.0	101.2	103.0	101.8	102.4
April 1	......	......	......	......	......	......	......	......	103.2	103.2	......	......
April 2	......	......	......	......	......	......	......	......	102.2	102.8	......	......
April 3	......	......	......	......	......	......	......	......	......	102.2	......	......
April 4	......	......	......	......	......	......	......	......	......	......	......	......
April 5	......	......	......	......	......	......	......	......	......	......	......	......

TABLE II.

Temperature Records of Registered Bulls which had Texas Fev
as a result of Tick Inoculation the first Summer following Defib
nated blood Inoculation.

DATE.	Admiral.		Charley.		Champion.	
1900.	A. M.	P. M.	A. M.	P. M.		
August 10	....	107.0	....	107.0	....	....
August 11	105.8	106.2	106.2	106.0	....	....
August 12	106.4	106.4	105.4	104.8	....	....
August 13	106.0	104.8	103.0	101.8	....	....
August 14	105.0	106.6	101.0	102.8	....	....
August 15	101.8	100.8	101.0	102.0	....	....
August 16	100.0	101.0	101.2	103.0	....	....
August 18	....	105.4	....	105.8	....	....
August 19	107.0	107.4	105.0	105.4	....	....
August 20	106.0	105.6	104.8	106.3	....	107
August 21	105.0	105.4	....	104.8	....	....
August 22	103.6	105.0	105.0	102.8	106.0	105
August 23	103.0	105.0	101.8	102.4	102.4	102
August 24	100.6	104.8	102.0	103.4	101.0	102
August 25	104.0	104.8	102.0	102.4	103.0	104
August 26	104.0	104.9	101.8	104.0	102.0	104
August 27	104.0	104.2	101.8	102.4	101.2	101
August 28	103.0	105.0	101.8	104.4	102.0	100
August 29	103.0	105.0	101.8	105.0	106.0	105
August 30	103.0	104.2	102.4	104.4	102.8	105
August 31	103.0	104.2	....	103.6	....	105
September 1	103.4	104.2	....	102.0	....	102
September 2	103.2	103.8	....	....	....	....
September 3	103.0	103.9	....	....	....	....
September 4	103.0	104.4	....	....	....	....
September 5	103.6	104.4	....	....	....	....
September 6	103.0	104.2	....	....	....	....
September 7	103.0	104.2	....	....	....	....
September 8	104.0	103.8	....	....	....	....
September 9	103.0	104.8	....	....	....	....
September 10	103.0	104.3	....	....	....	....
September 11	103.0	104.6	....	....	....	....
September 12	103.4	104.8	....	....	....	....
September 13	102.8	103.0	....	....	....	....
September 14	103.0	103.8	....	....	....	....
September 15	102.8	104.6	....	....	....	....
September 16	102.8	104.8	....	....	....	....
September 17	102.6	103.8	....	....	....	....
September 18	102.0	102.8	....	....	....	....
September 19	101.6	104.8	....	....	....	....
September 20	101.6	104.4	....	....	....	....
September 21	101.4	104.4	....	....	....	....
September 22	102.4	104.2	....	....	....	....
September 23	101.8	104.6	....	....	....	....
September 24	101.6	104.8	....	....	....	....
September 25	102.8	105.0	....	....	....	....
September 26	102.2	103.8	....	....	....	....
September 27	102.2	105.0	....	....	....	....

TABLE II—Continued.

DATE.	Admiral		Charley.		Champion	
1900	A M	P M.	A M	P M.	A M	P. M.
September 28	103.0	105.6	....	....	....	....
September 29	102.2	105.6	....	....	....	....
September 30	101.0	104.6	....	....	....	....
October 1	101.8	103.8	....	....	....	....
October 4	104.0	104.6	....	....	....	....
October 6	103.2	104.4	....	....	....	....
October 7	103.2	104.6	....	....	....	....
October 8	....	103.6	....	....	....	....
October 9	....	102.8	....	....	....	....
October 10	....	103.6	....	....	....	....
October 11	....	102.8	....	....	....	....
October 12	....	102.8	....	....	....	....
October 14	....	102.8	....	....	....	....
October 19	....	103.2	....	....	....	....
October 20	....	104.0	....	....	....	....
October 21	....	102.8	....	....	....	....

CLINICAL RECORDS OF THE ANIMALS INOCULATED WITH DEFIBRINATED BLOOD.

All of the cattle that were inoculated at Auburn were stabled at night, carefully handled during the entire period of inoculation. The ticks were kept off by weekly applications of kerosene oil emulsion. Neither cotton seed nor any of its products were fed them during the inoculation periods. Unless otherwise mentioned, the blood used in the inoculations was derived from a two-year-old Southern-bred Jersey heifer, which had been infested with ticks during its second summer, and had been tested for tuberculosis.

1. Admiral (see Table I), a red poll bull, bred in Illinois, arrived in Alabama Nov. 11, 1899, at the age of ten months, weighing 742 lbs. December 26, 1899, was inoculated with 1 cc of defibrinated blood. Very little, if any, primary inoculation fever occurred; but a fairly good secondary inoculation fever began January 25, 1900 (30 days after the inoculation), and continued until February 4. He was inoculated a second time February 21, 1900, with 1½ cc of defibrinated blood. A very slight rise of temperature appeared on February 26 and 27, March 3 and 4, and March 22. The inoculation fever periods in this animal were all more or less irregular, very slight or absent, excepting the secondary inoculation fever following the first inoculation. During the entire inoculation periods he exhibited no signs of ill health. Ticks first appeared upon him June 16. July 21 he was very much depressed or dumpish. August 10 he began to breathe rapid and shallow; morning temperature 107, and at noon 108 degrees Fah., remaining at about 106 for the next four days; then it dropped to normal for two days, rising to 107.4 on August 19. His

ature ranged between 103 and 105 until Septem-
remaining above normal nearly all of the time
ugust 19 to October 1. Thereafter there were
nal or irregular rises in his temperature (see
perature record in Table II). When the high
egan his urine became highly colored (port wine
and was excreted in large quantities; this condi-
ntinued for more than a week. The urine con-
a large quantity of albumen.
ist 11, about the beginning of the fever, his bowels
inactive; he was first given Epsom salts, and
w linseed oil with rectal injections of warm
–the last being given three times per day. But
lerate doses of purgatives and large enemas failed
luce a normal action of the bowels for 14 days.
vels began to act August 26, and the feces were
ft, dark in color and many times were covered
latinous mucus. His appetite was almost en-
ost; he nibbled at bran, sorghum, hay and grass;
not ruminate until he began to recover. Diges-
s almost entirely suspended. During the sus-
of digestion, fermentation and bloating were
led by giving internally dram doses of creolin
using the trocar and canula (tapping the r-
pounch to let out the gas). His weakness caused
lie down much of the time. About August 26
n to improve, his appetite became a little better;
tion and digestion were resumed, and his bowels
o act freely; yet recovery was slow and in fact
not yet completely recovered. Periods of improve-
nd periods of depression have appeared irregu-
r twelve months. August 8, 1899, two days be-
e fever began, he weighed 1027 lbs., and Septem-
805 lbs.; March 30, 1901, 775 lbs.; October 5.
05 lbs. His appetite, digestion and assimilation

have been deficient; have been below normal, and consequently very little improvement has been made.

August 13, 1900, there were 4,175,000 red cells in 1 ccm. of his blood.

August 20, 1900, there were 4,550,000 red cells in 1 ccm. of his blood.

August 23, 1900, there were 4,400,000 red cells in 1 ccm. of his blood.

August 17, 1901, there were 6,400,000 red cells in 1 ccm. of his blood.

September 26, 1901, there were 7,090,000 red cells in 1 ccm. of his blood.

The treatment of Admiral during the fever was directed toward keeping the bowels active by using rectal injections of warm water, and by giving, per mouth, small doses of raw linseed oil,—creolin and tapping being used to control bloating. Quinine in 30 to 120 grains doses were given every six hours to destroy the micro-parasite which causes the disease. To keep up heart action and tide over periods of great depression and weakness, tincture of digitalis was given in 2 to 4 fluid dram doses; also tinct. of nux vomica was used to stimulate the heart. Gention was given as a stomachic to improve the appetite and digestion after the acute stage had passed; also tincture chloride of iron and Fowler's solution of arsenic were tried, with the idea that they would increase the hæmoglobin and number of red blood corpuscles. But no appreciable results followed the use of the last two named drugs.

Clemintina (see Table I), a registered red poll heifer, bred in Illinois, was 1 year old when shipped to Auburn, Ala., arriving November 8, 1899, and then weighed 770 lbs. December 26 she was inoculated with 1 cc of defibrinated blood. She had no primary inoculation fever,

very slight secondary fever appeared February 1
bout 36 days after inoculation. February 21 she
l a secondary inoculation of 1½ cc of defibrinated
A very slight elevation of temperature occurred
.0 days after the second inoculation. Of all the
l blood cattle inoculated at the same time she
the least. During the shipment she accidentally
h calf and aborted July 26. Preceding and fol-
the abortion she had some fever and it is very
le that the abortion was caused by the fever. Ac-
to the Australian authorities Texas fever pro-
by defibrinated blood inoculation is often at-
by abortion in pregnant cows. This heifer has
the best condition, and has made an almost con-
growth from the time of her arrival in Ala-
to the end of her second summer. Novem-
llowing her first summer she weighed 1020
2 years old, and on August 10, 1901, she weighed
s. She dropped a bull calf about September 20,

pion of Alabama, (see Tables I and II), a short-
ull, bred in Missouri, arrived at Auburn, Ala.,
ber 8, 1899, at the age of 7 months, weighing 472
n shipping he caught cold and had an attack of
tis the first week after his arrival in Alabama.
ber 26 he was inoculated with 1 cc of defibrinated
If primary fever appeared it lasted only one day,
uary 11. A well marked secondary inoculation
ccurred from January 28 to February 7, beginning
after the inoculation, and continuing 12 days.
ry 21, 1900, he received a second inoculation of
defibrinated blood. The fever periods following
ond inoculation were indistinct and irregular.
the secondary fever period of the first inocula-

tion he became very sluggish, lost his appetite and decreased about 20 lbs. in weight. This calf was weak and unthrifty when inoculated, and had days of dumpishness and loss of appetite during the entire winter. While the reaction to the inoculation was well marked for only one period, yet he seemed to be affected more by the fever than any of the other five animals that were inoculated at the same time. During the summer of 1900 and of 1901 he became infested with ticks at different times, and for a short time in August had a period of high fever, going as high as 107 one evening (see Table II). Thereafter he made rapid gains, and on August 10, 1901, he weighed 1200 lbs. His growth during the second summer has been very good.

Sixth Gazelle of Maple Hill (See Table I), a shorthorn heifer, bred in Missouri, arrived in Alabama November 8, 1899, at the age of 11 months, weighing 692 lbs. Was first inoculated December 26 with 1 cc of defibrinated blood. The primary inoculation fever began January 7, (12 days after inoculation), and continued until January 26 (19 days). The secondary inoculation fever appeared about January 31; it was very mild and not distinctly marked. On February 21, this heifer received a second inoculation of 1½ cc of defibrinated blood, but no distinct fever reaction followed this inoculation. She lost her appetite one or two days, and had one day of short and rapid respirations during the primary fever of the first inoculation. February 16 and 22 a very few ticks were found on her. June 16 several ticks were found on her, having been in tick-infested pasture since April. July 16 she appeared dull and stupid, and July 24 her temperature rose a little above the normal; no doubt she had, at this time, a very mild attack of fever. She passed through the first summer

good gains and growing. At the beginning of
ulation period she weighed 685 lbs. at the close
4, 1900), 805. After this she passed her
d second summers and second winter, much of
e in tick-infested pastures. August 10, 1901,
ghed 1060 lbs., and August 11 dropped a fine 77-
er calf.

ess of Alabama, (see Table I), a full blood An-
fer, bred in Illinois; arrived in Auburn, Ala.,
er 8, 1899, at the age of 8 months, weighing 520
ecember 26 she was inoculated with 1 cc of de-
ed blood. The primary inoculation fever began
anuary 2 to 4, and continued until about Janu-
The secondary inoculation fever appeared about
day of January and first of February. Follow-
primary fever occasional irregular rises of tem-
e appeared. February 21, 1900, she received her
inoculation of 1½ cc of defibrinated blood; the
1 10th days following the inoculation she had
nd on the 20th day she had a temperature of 104
g and evening. The primary inoculation fever
ng her first inoculation was good and continued
than usual, and the heifer then became sluggish
her feed. At time of first inoculation she weighed
; near the close of the primary fever 540 lbs.; at
e of the inoculation periods (April 4), 570 lbs.;
ber 1, 1900, 700 lbs.; March 30, 1901, 810 lbs.

ey Gardner, (see Tables I and II), an Angus
ed in Illinois, arrived at Auburn, Ala., Novem-
899, at the age of 8 months, weighing 605 lbs.
er 26, 1899, he was inoculated with 1 cc of de-
ed blood. An almost imperceptible primary
ppeared about January 1. The secondary inocu-
ever began January 22 (27 days after the inocu-

lation) and lasted abuot 10 days. At no time did his fever reach 104. On February 21, 1900, he received a second inoculation of $1\frac{1}{2}$ cc of defibrinated blood. No fever followed this inoculation. After being infested with ticks some time in June or July, he had a rather severe attack of fever, beginning about August 10, when his temperature ran up to 107. This period of fever lasted three days; his temperature went up to 104-106 for four days. The fever checked his appetite and made him lose some in weight, but rumination, digestion and action of bowels were at no time completely suspended, as in Admiral's case.

August 8, 1900, just before the fever, he weighed 1015 pounds.

September 1, 1900, just after the fever, he weighed 930 pounds.

August 10, 1901, near close of his second summer, he weighed 1450 pounds, when about 30 months old.

REMARKS ON INOCULATION OF THE SIX CATTLE IN TABLE I.

One positive mistake that we made with the three full blood bulls which were inoculated at the same time as the three full blood heifers, was that they were not permitted to get ticks on them early in the spring immediately following recovery from the inoculation fever. The heifers were turned out with the herd cows and became infested with ticks early in the spring, while the bulls were kept by themselves in small pasture lot, and did not, in fact, get but few ticks on them until July, when the weather was hot, a dangerous time for fever. Another mistake was made in the second inoculation of all those that did not react well to the first inoculation. The second inoculation dose (coming from same source

as first) should have been $2\frac{1}{2}$ cc instead of $1\frac{1}{2}$ cc. The fever must be produced by the inoculation at least once and if possible twice before the animal is safely immune. The temperature should run up to, at lowest, 104 to 105.

TABLE III.

Temperature Records of Northern-Bred Grades that were Inoculated with Defibrinated Blood.

DATE	S. H. GRADE		A. GRADE I		A. GRADE II		A. GRADE III	
1899-1900	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
Nov. 24	102.0	102.0	104.0	103.0	102.0	102.6	102.6	105.0
Nov. 25	102.0	102.0	102.0	102.0	102.0	102.6	101.6	103.0
Nov. 26	102.0	102.0	102.0	102.6	102.0	102.0	102.2	102.6
Nov. 27	102.0	101.0	102.0	102.0	102.0	102.6	102.2	103.0
Nov. 28	102.4	103.0	102.6	102.0	102.0	103.0	102.0	102.0
Nov. 29	102.2	103.0	102.0	102.0	102.0	102.6	101.0	103.0
Nov 30	102.4	103.0	102.0	102.6	102.2	102.4	101.4	103.0
Dec. 1	104.0	104.0	102.0	102.6	103.6	104.0	102.6	103.6
Dec. 2	102.4	103.6	102.0	103.0	102.2	103.0	101.4	104.0
Dec. 3	102.4	102.4	102.0	101.6	102.0	102.2	103.0	102.2
Dec. 4	103.0	103.0	102.2	102.6	102.4	102.0	103.0	103.4
Dec. 5	103.2	102.8	102.0	102.4	102.0	102.2	103.4	102.6
Dec. 6	100.0	102.0	102.0	103.0	102.0	102.0	102.6	104.0
Dec. 7	101.6	102.0	102.0	103.0	102.0	103.2	101.6	103.0
Dec. 8	101.0	102.0	102.0	102.6	102.4	103.0	101.6	103.0
Dec. 9	102.6	102.6	103.0	103.6	102.0	102.2	101.0	102.0
Dec. 10	102.0	103.0	102.6	103.6	102.6	103.0	102.6	103.2
Dec. 11	104.0	103.0	103.0	103.2	103.0	103.4	102.6	103.4
Dec. 12	100.[illegible]	103.0	102.0	103.4	102.8	102.0	102.0	103.6
Dec. 13	100.6	102.6	102.0	102.4	101.8	103.0	100.8	104.0
Dec. 14	102.0	103.4	102.4	103.0	102.0	103.2	102.6	103.4
Dec. 15	100.0	102.0	102.0	103.0	102.0	102.4	101.4	102.6
Dec. 16	100.2	102.6	102.4	103.0	102.0	103.0	102.2	103.4
Dec. 17	101.2	102.6	102.6	103.0	102.0	102.6	102.4	103.2
Dec. 18	102.0	102.6	103.0	103.0	100.0	102.0	102.0	103.0
Dec. 19	102.2	103.6	102.6	104.0	102.4	103.6	100.0	103.0
Dec. 20	102.2	103.2	102.0	103.0	102.2	103.0	102.0	103.4
Dec. 21	102.6	102.6	102.6	102.8	102.0	103.0	102.4	102.4
Dec. 22	102.0	102.2	102.6	102.6	102.4	103.0	102.6	102.8
Dec. 23	101.0	102.0	102.6	103.0	102.0	103.0	101.0	103.0
Dec. 24	102.2	102.4	102.6	102.6	102.4	103.0	102.0	102.6
Dec. 25	101.0	102.0	102.4	103.0	102.0	102.4	102.2	102.4
Dec. 26	100.8	102.0	102.0	102.6	102.4	103.0	102.2	102.4
Dec. 27	100.0	102.0	102.4	103.0	102.2	102.6	102.2	102.6
Dec. 28	102.6	102.6	102.6	102.6	102.4	102.6	102.0	102.6
Dec. 29	102.0	102.0	102.6	103.0	102.4	102.0	102.0	103.0
Dec. 30	102.2	102.4	102.6	103.0	102.4	102.6	102.0	102.6
Dec. 31	102.0	102.4	102.6	103.2	102.0	102.4	102.4	102.6
Jan. 1	101.0	102.0	102.4	103.2	102.0	102.6	102.2	102.4
Jan. 2	102.0	102.2	102.0	102.2	101.6	102.0	102.4	102.6
Jan. 3	102.0	102.4	101.4	102.6	101.0	102.0	102.2	103.0
Jan. 4	102.2	102.6	102.0	102.2	102.0	102.2	102.0	105.0
Jan. 5	102.0	102.2	102.6	102.6	102.0	102.2	101.2	102.0
Jan. 6	101.[illegible]	102.0	102.2	102.6	102.4	102.6	102.0	102.0
Jan. 7	102.0	102.2	102.6	103.0	102.6	102.6	102.4	102.6
Jan. 8	102.0	102.4	102.0	102.4	102.2	102.6	102.0	102.2
Jan. 9	102.2	102.6	102.4	102.6	102.6	103.0	102.6	103.0
Jan. 10	101.6	103.0	102.6	103.0	102.6	102.6	102.0	102.6

TABLE III.—Continued.

DATE	S. H. GRADE		A. GRADE I		A. GRADE II		A. GRADE III	
1899—1900.	A M	P M.	A M	P M	A.M.	P M	A M	P M.
Jan. 11	103.0	103.0	102.6	103.0	103.0	103.2	103.4	103.0
Jan. 12	102.2	101.6	102.0	102.0	102.6	102.4	103.0	102.6
Jan. 13	102.2	102.0	102.0	102.4	102.6	102.6	102.6	103.0
Jan. 14	101.6	102.0	102.6	102.6	102.6	103.0	102.0	102.[illegible]
Jan. 15	102.4	102.6	102.6	102.6	103.0	102.6	102.6	102.4
Jan. 16	102.6	102.0	102.6	102.4	103.0	102.6	102.6	102.6
Jan. 17	102.2	102.4	102.6	102.0	103.0	102.6	102.0	102.0
Jan. 18	103.0	102.6	103.2	102.4	103.4	103.0	103.0	102.2
Jan. 19	103.0	102.4	103.0	102.4	103.6	103.0	102.6	102.2
Jan. 20	102.2	102.4	102.2	102.6	103.6	103.0	102.0	102.6
Jan. 21	102.4	102.6	102.0	102.6	102.6	103.0	102.0	102.6
Jan. 22	102.0	102.4	103.0	102.0	102.6	102.2	102.0	102.2
Jan. 23	102.0	102.2	102.0	102.4	102.6	102.6	102.2	102.6
Jan. 24	.....	102.4	.....	102.2	.....	102.6	.....	102.0
Jan. 25	102.0	102.6	102.0	102.6	103.0	102.6	103.0	102.2
Jan. 26	102.0	102.4	102.0	102.6	102.6	102.4	102.4	102.6
Jan. 27	102.0	102.4	102.0	102.6	102.6	103.0	102.0	102.4
Jan. 28	102.0	102.2	102.0	102.6	102.2	102.4	102.0	102.2
Jan. 29	102.0	102.2	102.0	102.6	102.6	103.0	102.0	102.2
Jan. 30	101.4	102.0	102.0	102.0	102.0	102.2	101.6	102.0
Jan. 31	102.4	102.6	102.4	102.6	102.6	103.0	102.4	102.6
Feb. 1	102.2	102.0	102.0	102.4	102.6	102.0	101.0	102.0
Feb. 2	102.4	102.0	102.6	103.0	103.0	103.0	103.0	103.2
Feb. 3	102.0	102.0	102.0	102.2	102.6	102.2	102.0	103.0
Feb. 4	102.4	102.0	102.6	102.6	102.6	102.4	102.6	102.6
Feb. 5	102.0	102.0	102.4	102.0	102.6	102.4	102.4	102.0
Feb. 6	103.0	102.6	103.0	102.6	102.6	102.4	102.6	102.4
Feb. 7	103.2	102.6	103.0	102.0	103.0	102.2	102.6	102.0
Feb. 8	104.0	103.0	103.2	102.6	103.2	103.0	103.0	102.6
Feb. 9	102.6	102.0	103.0	102.6	102.6	102.6	102.0	102.0
Feb. 10	103.0	102.6	103.0	102.6	102.6	102.4	102.2	102.2
Feb. 11	102.0	102.0	102.6	102.0	102.6	102.0	102.0	101.6
Feb. 12	103.4	103.0	102.6	102.0	103.0	102.6	103.0	102.6
Feb. 13	102.6	102.4	102.0	102.4	103.0	102.6	102.0	102.0
Feb. 14	102.6	102.0	102.0	103.0	102.0	102.0	102.6	102.0
Feb. 15	102.0	102.2	102.0	102.6	102.6	102.6	103.0	103.0
Feb. 16	102.6	103.0	102.0	102.6	102.4	102.2	102.4	102.0
Feb. 17	102.6	102.6	102.0	102.4	102.2	102.4	102.2	102.0
Feb. 18	102.6	102.4	102.0	102.0	102.4	102.0	102.0	102.0
Feb. 19	102.6	102.0	101.2	102.6	102.0	102.2	102.0	102.0
Feb. 20	101.6	102.0	102.0	102.4	102.4	102.6	103.0	102.6
Feb. 21	102.2	102.6	102.0	102.2	102.4	102.6	102.4	102.6
Feb. 22	102.0	102.2	102.0	102.1	102.6	102.2	102.6	102.4
Feb. 23	101.2	.....	102.0	.....	102.6	.....	102.6	.....

The four Northern-bred grades that were brought to Auburn, Ala., November 8, 1899, with the six full bloods, were inoculated one month before the full bloods, and were differently handled and fed. They were all inoculated the first time November 24, 1899, with 1 cc of defibrinated blood, derived from the same two-year-old Southern-bred Jersey heifer; and on January 24, 1900, they all received a second inoculation of 1½ of defibrinated blood. During the inoculation periods they were fed small rations of bran and very poor hay; housed at night and bad days, and allowed the run of a dry lot on good days. (See temperature records in Table III).

Shorthorn Grade Heifer, bred in Missouri, about 8 months old at time of arrival in Alabama, and weighed 320 lbs. The primary fever began about November 28 or December 1, and continued until about December 5th. and rose slightly again December 9, 10 and 11. Her temperature came up again December 18, and irregular slight elevations of temperature occurred until the second inoculation on January 24. During this first period a low fever prevailed, and the heifer exhibited weakness and an unthrifty condition. The low fever following the second inoculation was a little higher and more unbroken or continuous than the fever following the first inoculation. This heifer was not in good condition at the beginning of the inoculation periods, and was not fed a sufficient quantity of good feed during the fever. A liberal supply of good feed is always essential during inoculation fever. She was turned into a tick-infested pasture about March 1, and became so badly infested with ticks in April that it was necessary to get her up and treat her with kerosene oil emulsion in order to remove them. This heifer did make some growth during her first summer, but did not begin

ove in a normal, healthy manner until the spring . September 1, 1901, she weighed about 800 lbs.

Grade Heifer No. I; bred in Illinois, about 8 old at time of arrival in Auburn, Ala. About er 8 the primary reaction began. Slight irregus of temperature occurred every few days until inoculation on January 24, 1900. Primary reegan about February 6, and lasted about 4 days. ry 23 she was turned into tick-infested pasture e herd, and became infested with ticks early in ing. She made good gains in flesh during the , and on November 10, 1900, weighed 725 lbs. the second summer she developed without any and now weighs about 900 lbs.

Grade Heifer No. II, bred in Illinois, at time al in Auburn, Ala., 8 months old, and weighed Primary inoculation fever appeared about De1. Secondary inoculation fever not very difilocated, but probably began about January 9. ature rises were irregular and very mild, followh first and second inoculations. She never showed ms of ill health and at the end of the inoculation she weighed 490 lbs. She was turned into a ested pasture and became infested with ticks the spring, and never showed any signs of sickeighing at the end of the first summer 670 lbs. end of the second summer she weighed about 800

Grade Heifer No. III; bred in Illinois, about 8 old at time of arrival in Auburn, Ala., and 420 lbs. About December 1 the primary reactan. The secondary inoculation fever not very tly located unless January 7 to 13 or January 18 e so regarded. The primary reaction following

the second inoculation began about February 3, and the secondary reaction appearing about February 20. No reaction is high or very distinctly located. This heifer was very wild and mean to handle, and was not fed during the first and second summers and the second winter, as were Nos. 1 and 2. At the end of the first summer she weighed 610 lbs., and in September, 1901, she weighs about 800 lbs. She became infested with ticks the first summer and several times since, but has never exhibited any signs of ill health.

TABLE IV.

ture Records of four Registered Angus Calves. Inoculated rinated Blood.

E	Barnes, H. I		Barnes, H. II		Barnes, B.		Little B.	
	A. M.	P. M.	A. M.	P. M	A. M.	P. M.	A. M.	P. M.
13	103.0	102.6	103.0	102.6	102.0	102.2	......	......
14	102.0	103.6	102.6	102.6	102.0	103.6	......	......
15	102.6	103.0	102.6	103.0	101.6	102.0	......	......
16	102.6	103.2	102.6	103.0	102.0	103.0	......	......
17	102.6	103.2	102.6	103.2	102.0	103.0	......	......
18	102.6	102.0	102.6	102.0	102.0	102.2	......	......
19	102.0	103.2	102.0	104.0	101.0	103.0	......	......
20	103.0	103.2	103.4	103.6	101.6	103.0	......	......
21	103.4	103.6	103.6	105.0	102.0	105.0	......	103.0
22	102.0	103.6	102.6	103.6	102.0	102.0	102.0	102.0
23	102.6	103.0	103.0	104.0	102.0	102.6	102.0	102.0
24	102.6	102.6	103.0	102.6	102.0	102.0	103.0	102.0
25	102.6	103.0	102.6	102.6	102.0	102.2	102.6	102.0
26	104.6	103.0	103.2	103.0	101.2	102.0	102.0	102.0
27	103.6	103.0	103.0	103.2	101.6	102.0	102.0	102.0
28	102.6	102.2	102.0	102.0	102.0	102.0	102.0	102.0
....	102.6	102.4	102.0	102.0	102.2	102.0	102.2	102.0
....	102.6	103.0	103.0	104.0	102.0	103.0	103.0	104.0
....	102.0	102.6	102.0	102.6	103.0	102.6	104.0	105.0
....	103.0	103.6	102.6	103.0	102.0	103.0	104.0	104.0
....	102.6	103.0	102.0	102.6	102.0	102.6	105.0	106.0
....	102.6	103.0	102.6	103.0	102.0	102.6	106.0	106.0
....	102.0	102.6	102.6	102.6	102.0	102.0	106.0	105.2
....	102.0	102.0	102.0	102.0	101.2	102.0	104.2	103.4
....	102.0	102.6	102.0	102.6	102.0	104.0	102.6	103.0
....	103.0	103.0	103.0	103.0	103.0	102.6	103.0	103.0
....	103.0	103.6	103.0	102.6	103.0	103.0	102.6	102.0
....	102.6	102.6	102.6	102.6	103.0	102.6	102.0	102.0
....	102.4	102.6	102.4	102.6	103.0	103.0	102.0	103.0
....	103.0	103.0	103.0	103.0	102.0	103.0	104.4	105.0
....	102.6	102.4	103.0	102.6	104.0	103.0	104.0	103.2
....	102.6	103.4	102.0	103.4	101.6	103.0	103.0	102.0
....	102.2	102.0	102.0	102.6	102.0	102.6	102.0	102.0
....	102.4	103.0	102.0	102.6	102.0	102.6	102.0	102.0
....	102.6	103.0	102.6	103.4	103.6	103.0	102.6	101.4
....	103.0	102.6	103.0	102.6	103.2	103.0	102.6	102.0
....	102.0	103.0	102.4	103.2	103.0	103.6	102.6	102.2
....	103.0	103.2	102.0	102.6	102.6	102.6	102.0	102.0
....	103.0	103.2	102.6	103.2	103.4	104.0	102.4	102.6
....	102.0	102.0	103.0	102.6	103.0	103.0	103.0	102.0
....	102.6	102.4	102.6	103.0	103.0	103.4	102.6	102.0
....	102.2	103.0	102.4	103.0	102.4	103.0	102.0	102.2
....	102.0	103.0	102.0	102.6	102.6	103.2	102.2	......
....	102.0	102.6	101.6	102.6	102.6	103.0	......	......
....	102.0	102.2	102.0	102.0	102.0	102.6	......	......
....	102.6	102.6	102.0	102.2	102.6	103.0	......	......
....	102.0	102.4	102.0	102.6	102.2	103.0	......	......
....	102.6	103.2	102.0	102.0	102.6	102.6	......	......
....	102.6	102.2	102.4	103.0	102.2	103.0	......	......
....	102.6	102.4	102.0	102.0	103.0	102.6	......	......
....	102.6	102.4	102.2	102.0	103.0	103.0	......	......
....	102.0	.....	102.0	.....	102.2	.....	......	......

In Table No. 3, "Barnes, H., I," "Barnes H., II," and "Barnes, B.," represent two heifers and one bull. They are full blooded Angus calves about 6 months old at time of their arrival in Alabama, and were bred in Illinois. February 11 they arrived in Auburn, Ala., and February 13 they were each inoculated with 1 cc of defebrinated blood derived from the same two-year-old Alabama-bred Jersey heifer. The inoculation fever periods are fairly well marked (see Table No. IV), but are somewhat irregular. These calves were fed shorts, corn meal, and received daily from 3 to 4 gallons of milk from two Alabama-bred Jersey cows. The milk very probably had no immunizing power, but it kept these calves in excellent condition to withstand the inoculation fever. They all grew and gained in weight during the inoculation period. April 5, 1900, they were taken to the home of their owner, Hon. R. B. Barnes, Opelika, Ala., where they have spent two summers without showing any symptoms of Texas fever. The heifers were turned into tick-infested pastures and the bull was kept by himself in a small pasture where he did not get many ticks on him the first summer. Consequently in November following the first summer the bull was given a second inoculation of 1½ cc of defibrinated blood. The cattle have suffered no inconvenience from the inoculation, and the exposure to tick inoculation during the second summer.

The "Little B." in Table No. IV. represents an Angus bull calf, bred in Missouri. He arrived at Auburn, Ala., February 20, 1900, and was then about 10 months old. This calf was small and thin at time of arrival, but on February 21 he was inoculated with 1 cc of defibrinated blood from the same Alabama-bred Jersey heifer. Notice by the table that his reactions or inoculation fever periods were better marked than were those of the

Barnes calves. This is partly due to the fact that he was older and was not fed milk to keep him stronger and better able to resist the micro-parasites. He was fed shorts, wheat bran and corn meal, and maintained a growing appetite and made good gains in weight during the entire 35 days he was in Auburn. When shipped to his owner, Mr. W. G. Little, Livingston, Ala., he could not be forced into the small crate in which he came to Auburn from Missouri. This animal has now passed two summers in Alabama, and has never exhibited any signs of Texas fever.

TABLE V.—SUMMARY OF CATTLE INOCULATED WITH DEFIBRINATED BLOOD IN ALABAMA.

No.	Owner.	Breed.	Age.	Native State.	Time of Arrival in Ala.	First Inoculation.	Dose.	Second Inoculation.	Dose.	Deaths from Inoculation.	Remarks.
3	Expt. Station,	Angus grades	8 mo's.	Ill......	Nov. 8	Nov. 24	1cc	Jan. 24	1.5cc	......	
1	" "	S. Horn grade	8 "	Mo....	"	"	1cc	"	1.5cc	.....	
1	" "	S. Horn Bull .	8 "	Mo....	"	Dec. 26	1cc	Feb. 24	1.5cc	.....	
1	" "	S.Horn Heifer	1 year	Mo....	"	"	1cc	"	1.5cc	....	
1	" "	R. Poll Bull..	1 "	Ill. ...	"	"	1cc	"	1 5cc	......	Had severe fever following
1	" "	R. Poll Heifer	1 "	Ill. ...	"	"	1cc	"	1.5cc	......	Summer.
1	" "	Angus Bull ..	8 mo's.	Ill. ...	"	"	1cc	"	1 5cc	......	
1	" "	Angus Heifer.	8 mo's.	Ill.. ..	"	"	1cc	"	1.5cc	......	
1	Barnes,......	Angus Bull.	6 mo's,	Ill......	"	Feb. 12	1cc	Nov.	1.5cc	......	Given Jersey milk during Inoc.
2	"	Angus Heifers	6 mo's.	Ill. ...	Feb. 9	"	1cc	....	....	......	" " " " "
1	Little.......	Angus Bull ..	10 mo's	Mo....	"	Feb. 21	1cc	....	....	....	
1	Dumas.......	S. Horn Bull..	9 mo's.	Tenn. ..	Feb. 20	Nov	1cc	....	....	......	Passed first sum'r without fever
2	"	S. Horn H. ..	9 mo's.	"	Nov.	"	1cc	....	....	......	" " " " "
1	Mr. G.......	Herefords....	2 years	Mo.....	"	Mch 13.	2cc	....	....	......	
1	T. and P.....	Jersey H.....	2 years.	Ky ...	Winter.	Mch 14.	2cc	......	....	1	The last nine were inoculated
1	Sadler.	Jersey H.....	2 years.	Ky. ..	"	"	2cc	......	.....	1	by Fred G. Matthews, of South
1	Proctor	Jersey H.....	18 mo's.	Ky....	"	"	2cc	......	......	....	Florence, Ala.
1	Thurman. ..	Jersey B.	2 years	Ky.....	"	"	2cc	......	....	......	
1	Cohens.	Jersey H.....	2 years.	Ky.....	"	"	2cc	......	....	......	
1	Nathan.	Jersey Cow ..	4 years.	Ky.....	"	"	2cc	......	....	....	
1	"	Jersey Calf...	6 mo's	Ky.....	"	"	2cc			....	

The total number of cattle inoculated was 27, and out of this number two died of inoculation fever and one was seriously injured by severe attack of Texas fever as a result of tick inoculation the first summer. At least four others had the fever some

Clinical Notes on Dumas Short-Horns.

The two Shorthorn calves, owned by Dumas, of Arlington, Ala., were inoculated only once. (see Table V). This was done in November. The following August Mr. Joel Dumas writes me stating that about ten days after the calves were inoculated the primary inoculation fever appeared and continued about two weeks, the temperature ranging from 103 to 106. The heifer's temperature was invariably higher than that of the bull calf. During the high fever the bowels were kept active by drenching the calves with raw linseed oil, and when they would not eat they were drenched with milk. After recovery they were turned into a pasture with other cattle, and "have had ticks on them all along." He says: "My Shorthorn calves have done very well, and I think now they are perfectly immune." Nov. 1., these calves were safe.

Notes on the last nine cases in Table No. V:

F. G. Matthews, of Florence, Ala., inoculated these animals, and under date of April 8, 1901, writes me as follows:

"I first measured the dose in a small two drachm graduated, allowing something over a half drachm for a dose (2 cc). Nine head of cattle were inoculated. Seven of them were Jerseys (one 6 months old, one 18 months old, four were 2 years old, and one was 4 years old); they came from Kentucky; the other two were 2 year old Herefords, and came from the St. Louis market. All of these cattle were brought to Alabama during the past winter.

"The vessels used were sterilized by placing them in cold water and bringing it up to boiling.

"On the 13th of March I drew the blood from a native scrub bull, 18 months old, defibrinated it, and immediately inoculated the Herefords.

"On the 14th of March I drew 2 ounces of blood, pared it, and immediately inoculated T. and P.'s 2-y old Jersey cow; a few minutes later, Sadler's 2-year Jersey cow; about 15 minutes later Proctor's 18-mo old Jersey heifer; about 30 minutes later Thurman' year-old Jersey bull; about an hour later Cohen's 2-y old cow (she was in wood's pasture, and had to hunted), and about an hour later we secured Nath 4-year-old cow and 6-month-old calf and inoculated b of them. (Numbered in the order named). Cows 1 and 2 died March 25. On that day the temperatur No. 3 was 104; No. 4, 103; No. 5, 105. March 26, N 107; No. 4, 103; No. 5, 105; Nos. 6 and 7, 104. N was too weak to stand up long at a time. March 27, 3, 105.5; No. 4, 102.5; No. 5, 102.5; Nos. 6 and 7, These temperatures remained this way for several d and then subsided. The animals suffered loss of a tite one or two days. The bull's temperature went again in a few days to 104, and No. 3 developed a sw ing under the throat and weeping at the eyes—t conditions passed off in a few days.

"I can not understand why Nos. 1 and 2 should h died and No. 3 became so violently affected when others took the regular or normal course. Possibly severity of the fever in these three cases was due to freshness of the blood at the time they were inocula the blood being somewhat old at the time the ot were inoculated."

"Very respectfully,

"Fred G. Matthews."

The time of year when these 9 head of cattle were oculated was not altogether suitable—the weather a little too warm. The best time of year for inocula is from November 1st to March 1st. Moreover, som

these cattle were too old to be inoculated with safety, and the dose of defibrinated blood was too large for a single or first inoculation. The strength of the blood of an immune animal is never known until it is tested by inoculation; hence it is always safest to use the minimum dose in the beginning or the first time the blood is used. All of these animals should have been collected at one place so that there would have been no delay in the inoculations following the drawing of the blood and the defibrinating it. The vessels were not sufficiently sterilized. They should have been boiled at least for thirty minutes, and for safety one hour.

TABLE VI—SUMMARY OF NORTHERN-BRED CATTLE SHIPPED INTO ALABAMA IN THE LAST 3 YEARS and acclimation attempted by natural tick inoculation.

No.	Age when brought to Alabama.	Sex.	State where bred.	Breed.	Owner.	County in Alabama.	Died of Texas Fever	Living and acclimated.	REMARKS.
1	1 year.	bull		Polled Durham		Wilcox		1	
1	8 mo's.	heifer		Red Poll	Lambert	"		1	Kept away from Southern cattle.
1	18 mo's.	"		" "	"	"		1	Separated from herd cattle.
2	14 mo's.	bulls		" "	"	"	2		Allowed to run with herd
2	18 mo's.	"		" "	"	"		2	Well cared for and isolated.
2	3–5 yrs.	cows		" "	"	"	1	1	
1	4 yrs.	bull	Tenn	" "		"	1		
1	1 yr.	"		R. P.& S. H.Cross		"		1	Kept isolated.
1	1 yr.	"		Shorthorn		"		1	" "
1	18 mo's.	"		"		"		1	
1	2 years,	"		Red Poll		"		1	
1	45 days.	"		Devon		"	1		
1	45 days.	"		"		"		1	
2	18 mo's.	heifers		Red Poll		"		2	
1	9 mo's.	bull	Ill	Angus	Kernachan	Colbert		1	Well cared for.
1	"	heifer	"	"	"	"		1	" " "
1	1 year.	"	Tenn.	"	"	"		1	" " "
1	"	bull	Mo.	Hereford	Swope	La wrence		1	Isolated and stabled.
5	2 yr's.	heifers	"	"	"	"		5	" " "
1	9 mo's	bull	Ill.	Angus	Hare	Monroe		1	
3	10-18mo	bulls.	Penn.	Devons		Chambers	1	2	
15	"	heifer	"	"		"	4	11	

TABLE VI—Continued.

1	4 yrs	bull	Tenn.	Red Poll grade	Jones	Lee	....	1	Taken to Florida before summer.
1	4 yrs.	cow	"	" "	"	"	1	....	Died of Texas Fever in July.
1	8 yrs	cow	"	S. P. & R. P. Cross	"	"	1	....	
1	5 yrs.	cow	"	" "	"	"	....	1	
1	18 mo's.	heifer	"	Shorthorn, grade	"	"	1	....	
1	7 mo's.	heifer	"	Red Poll, grade	"	"	....	1	
9	1 year	....	Neb	Shorthorn	McLatchy	Washington	2	7	Two of the 7 sick at time of report
1	15 mo's.	bull	Ohio	"	Talson	Etowah	....	1	Kept isolated.
1	16 mo'f	heifer	"	"	"	"	....	1	" "
1	....	bull	....	Red Poll grade	Hamilton	"	....	1	
1	1 yr	bdll	Mo	Hereford	Rodgers	Sumter	....	1	
2	1 yr	heifer	Mo	"	"	"	2	....	
1	1 yr	bull	Ohio	Red Poll, grade	McCain	"	1	....	
1	1 yr	bull	Tenn.	" "	McCain & Cobb.	"	....	1	
1	1 yr	bull	"	" "	Horn	"	....	1	
1	1 yr	bull	"	" "	Scarborough.	"	....	1	
1	1 yr	bull	"	Angus	Thornton	"	....	1	
1	6 mo's	bull	Ill.	"	Ennis	"		1	
2	6 mo's.	heifer	Ill.	"	"	"	....	1	
1	6 mo's.	heifer	Tenn,	Shorthorn	Paul Gee	"	....	1	Had Texas Fever and recovered.
1	6 mo's.	bull	"	"	" "	"	....	2	" " " " "
1	6 mo's.	heifer	"	Red Poll	" "	"	....	1	" " " " "
2	6 mo's.	heifers	"	Shorthorn	R. H. Seal	"	....	1	" " " " "
2	9 mo's.	heifers	"	"	Seymour	"	....	2	
1	9 mo's.	bull	"	"	"	"	....	2	

TABLE VI.—Cont'd.

Summary of Northern-Bred Cattle shipped into Alabama in the last three years, and acclimation attempted by natural tick inoculation.

No.	Age when brought to Alabama.	Sex.	State where bred.	Breed.	Owner.	County in Alabama	Died of Texas Fever.	Living and acclimated.	REMARKS.
10	6-12 mos	3 b, 7 h	Tenn.	Shorthorn	F. I. Derby	Sumter	2	8	
2	6-22 mos	1 b, 1 h	"	"	J. Sims	"	1	1	
1	6 mo's.	heifer	"	"	Wallace	"	1		Died second year.
1	1 yr	bull		"	Comer	Bullock		1	
1	3 yrs	bull		"	"	"		1	
4	4 yrs	cows		"	"	"	1	3	
1	4 yrs	cow		Jersey	Haughton	"		1	
1	1 yr	bull		Shorthorn	Foster	"	1		
3	1 yr	heifers		"	"	"	3		
1	2 yrs	heifer		"	"	"		1	
1	2 yrs	heifer		Jersey	"	"		1	
5	1 yr	1 b, 4 h.	Miss (?)	Herefords	Rainer	"	3	2	Ship'd Mch from Columbus, Miss.
1	7 mo's.	bull	Tenn.	Shorthorns	Culver	"		1	Shipped in October to Ala.
2	7 mo's.	heifers	"	"	"	"		2	" " " " "
1	8 mo's.	bull		Angus	Goldthwaite	Montgom'y		1	Weight 1400 lbs, at about 30 mo's.
1	5 mo's.	bull		Short horns	Marks	"		1	Shipped Nov. 1899. to Ala.
2	8 mo's	1 b, 1 h		"	Gunter	"		2	
2	8 mo's.	1 b, 1 h		"	P. Tyson	"		2	
4	6 mo's.	1 b, 3 h.		"	McLemore	"	1	3	
8	8 mo's.	1 b, 2 h		"	T. W. Oliver	"		3	
1		cow		"	Smith	"		1	
2		1 b, 1, c.		Red Poll	"	"		2	
1		bull		Polled Durham	"	"		1	
2		..		Short horns	Torbert	Lee		2	

The total number of Northern-bred cattle on this list is 139. This, however, does not include all the Northern-bred animals shipped into Alabama during the past three years. There were many others brought into Alabama during the same period but we were unable to get authentic reports about them.

Of the total number reported (139), there were 31 fatal cases of fever; or 22 3 per cent. of the entire number died of Texas fever from inoculation, At the same time it should be noted that some of these cattle are still susceptible to Texas fever because they have been kept entirely free from ticks. Comparing the results (22.3 per cent. loss) with about 10 per cent. of deaths of Dr. Francis, where 1500 cattle were inoculated with defibrinated blood to produce immunity, gives a decided favorable balance for the new inoculation method. Or, compare the 22.3 per cent. loss with the 8 per cent. of deaths as shown in the summary of defibrinated blood inoculations made in Alabama.

In order to aid Alabama farmers who may desire to embark in the stock business by buying Northern-bred cattle, the veterinarian of the college and station will inoculate such animals with defibrinated blood, providing his expenses are paid to and from the place where cattle are to be inoculated. Parties desiring such inoculations will please notify the veterinarian in advance so that a date may be fixed to suit his convenience.

All farmers who have bought Northern-bred or foreign-bred cattle into Alabama at any time during the past three years will do us a great favor by reporting the results of their respective attempts at acclimating their cattle. Please give the age of each animal at time of arrival in Alabama; sex, breed, State from whence they came, how long said cattle have been in Alabama, how many are safely acclimated, with method of acclimating, and how many died with Texas or acclimating fever. If a number of animals were acclimated, the report may be tabulated as in Table VI.

We also solicit reports of all contagious or infectious diseases occurring among farm animals in Alabama. In case of serious or alarming outbreaks report directly to the veterinarian, and if possible, and best, he will at once visit the locality to determine the cause, and suggest ways of preventing and treatment.

I wish to take this opportunity to thank all those who so kindly sent in reports, and hope this bulletin will in part repay them for their trouble. I am especially thankful to Mr. R. W. Clark, who has charge of the stock at the Experiment Station, and who so carefully and faithfully looked after ten of the inoculated cattle that were directly in his care.

REMEMBER.

1.—That an animal sick with Texas fever can not infest or transmit the disease to healthy cattle.

2.—That the only known means by which the microparasite that causes Texas fever can be transmitted from diseased cattle to healthy ones is through two generations of the Southern cattle tick.

3.—That tick-free cattle never have Texas fever as long as they are tick-free.

4.—That cattle with Texas fever have or have had ticks upon them.

5.—That all cattle must acquire immunity after birth by having one or more attacks of Texas fever.

6.—That immunity to Texas fever is not inherited.

7.—That Southern-bred cattle have Texas fever when very young (sucking calves), and are usually but slightly affected by it.

8.—That the older the animal the more severe the fever; the older the animal the greater the mortality.

9.—That all cattle north of the government quarantine line are susceptible to Texas fever.

10.—That all Southern-bred cattle raised on tick-free farms and tick-free town lots are susceptible to Texas fever.

11.—That immune cattle will lose their immunity if kept free of ticks for two or more years.

12.—That in hot weather Texas fever is usually more acute and fatal than in cool seasons.

13.—That the best time to bring Northern-bred or foreign-bred cattle into Alabama is between November 1st and March 1st.

1.—That it is safer to bring young sucking calves into Alabama for acclimation than cattle over one year old.

15.—That sucking calves (2 to 4 months old,) can be shipped into the South by express; fed milk from a Southern-bred and immune cow, and be made immune by natural tick innoculation with a great degree of safety or little danger of loss.

16.—That one or two inoculations with defibrnated blood derived from an immune animal will produce a relatively safe immunity to Texas fever.

17.—That the best age for inoculating with defibrinated blood is one year or less.

18.—That the best time for the inoculation is from November 1st to March 1st.

19.—That inoculations should not be attempted in hot weather.

20.—That pregnant cows are liable to abort when they have inoculation or Texas fever.

21.—That inoculated animals should receive the best of feed and care during and after the inoculation fever.

22.—That from 50 to 90 per cent. of Northern-bred or susceptible cattle die with Texas fever when they are turned into tick-infested pastures, and allowed to rustle for themselves.

23.—That less than 10 per cent. of susceptible cattle are lost when they are made immune by the defibrinated blood inoculation method; about 3 per cent. die with the inoculation fever, and about 7 per cent. die with Texas fever as a result of tick inoculation during the first summer.

24.—That it is best to keep all cattle from becoming literally covered with ticks.

25.—That if you are adjacent to the government quarantine line it is best to exterminate all the ticks on your farm and farm animals.

ce—Parties who are interested, and who may a Farmers' Institute held in their town or city, ase write the veterinarian of the college and sta- ating when they desire the institute, and about ny farmers they can get to attend said meeting. nds for this work are limited, but we aim to visit y counties as possible with our means during the We can visit one or two places each month while is in session, and a number of counties during nmer vacation. Dr. C. A. Cary is Official Di- of Farmers' Institute for the station and college.

o. 117. DECEMBER, 1901.

ALABAMA.

tural Experiment Station

OF THE

LTURAL AND MECHANICAL COLLEGE,

AUBURN.

RCHARD NOTES.

By C. F AUSTIN.

MONTGOMERY, ALA.
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1901.

The Bulletins of this Station will be sent free to any citizen the State on application to the Agricultural Experiment Statio Auburn, Alabama.

ORCHARD NOTES.

The season of 1901 was in many respects a favorable one for Alabama fruit-growers. The very mild preceeding winter had left the trees in excellent condition. Some of the earlier blooming plums escaped the frost and bore a good crop. The crop of fruit in the Experiment Station orchard was not as large as that of the preceding year; but it must be stated that the crop secured during 1900 was unusually large. The spring of 1901 was very late, wet and cold, and, therefore, prevented in many varieties a normal setting of fruit. As a result of the late spring the earlier varieties fruited from one to two weeks later than usual.

The young apple orchard planted in the years 1897 and 1900 continues to be very promising. Nearly every variety made a strong, vigorous growth during the past season. The method of treatment was the same as outlined in Bulletin 112, and has proven satisfactory. Some of the varieties planted in 1897 bore their first fruit this season.

Observations as to the prevalence of apple leaf rust (*Roestelia*) showed that the following varieties were affected:

Aikin, slightly.
Babbitt, slightly.
Battyani, slightly.
Buncomb, slightly.
Bledsoe, slightly.
Bradford, slightly.

Benoni, slightly.
Cillagos, slightly.
Cannon Pearmain, slightly.
Carolina Greening, very badly.
Cooper's Red, slightly.
Carter's Blue, very baldy.
Chattahooche, very badly.
Dam, slightly.
Early Harvest, slightly.
Elgin Pippin, slightly.
Equinettelee, badly.
Family, very badly.
Grime's Golden, slightly.
Hands, slightly.
Homing, slightly.
Haygood, very badly.
Jeffries' Everbearing, slightly.
Jonathan, very badly.
Julian, badly.
Keeskemet, slightly.
Moultries, badly.
Mangum, badly.
Marvina, badly.
Nickajack, very badly.
Mavarack Sweet, slightly.
Oszi-vaj, slightly.
Pear (or Palmer), slightly.
Red Limbertwig, slightly.
Rawls Janeton, slightly.
Red June, badly.
Rome Beauty, very badly.
Red Beitigheimer, slightly.
Rodes Orange, very badly.
Sekula, slightly.
Summer Wafer, slightly.

nockley, very badly.
enator, very badly.
nta, badly.
veet Bough, slightly.
hornton's Seedling, slightly.
aunton, slightly.
exas Red, slightly.
alalyfi, badly.
ellow English, slightly.
opp's Favorite, very badly.
ellow Horse, slightly.
ork Imperial, slightly.

he following varieties were free from rust this sea-

pple of Commerce.
rkansas Black.
uda Summer.
lack Ben Davis.
hampion.
ooper's Early.
pir.
anny.
all Pippin.
arvenstein.
yari Piros.
ershall Cox.
ew's Crab.
ennings.
ennard's Choice.
aggar.
etell.
ammoth Black Twig.
aiden Blush.
oble Savor.

Pasman.
Ponjik.
Red Astrachan.
Early Red Margaret.
Sabadka.
Summer Queen.
Saxon Priest.
Selymes.
Summer Cheese.
Shackleford.
Tuscaloosa Seedling.
Winesap.
Yakor.
Yates.

Early Red Margaret, Sabadka, Winesap, and Yako which showed rust last year, escaped this, and, in addi tion to those affected last year, there are thirty-fou more varieties affected this season. A greater numbe of the Hungarian varieties were affected this year tha last year. Resistant varieties have for the past few sea sons been giving a good deal of promise, but this seaso so many more varieties were affected than usual, tha it is probable we have no varieties in our orchard tha are perfectly resistant to the disease.

Spraying to Prevent Rust.—To determine if ver thorough spraying with Bordeaux mixture would hav any effect upon the rust, one tree of each variety was se lected and kept very carefully sprayed from early sprin until late in the fall. The Bordeaux mixture was use at the rate of six pounds of copper sulphate and si pounds fresh lime to fifty gallons of water.

The varieties selected for this spraying experimen were affected during the season of 1900 as follows:

Carter's Blue, slightly.
Cooper's Red, moderately.

Dam, slightly.
Early Red Marguerite, badly.
Family, very badly.
Hames, slightly.
Horse, moderately.
Jonathon, very badly.
Red June, slightly.
Santa, badly.
Senator, badly.
Shockley, badly.
Thornton's Seedling, slightly.
Winesap, slightly.
Yakor, slightly.

The trees were very carefully sprayed on the following dates during the season: March 24th, before growth started; April 25th, May 4th and 22nd, June 5th and 20th, July 23rd, August 9th and 28th.

On October 10th the trees were examined and the following notes taken showing the relative amount of rust on the sprayed trees. The trees at this time were heavily covered with the Bordeaux mixture:

Carter's Blue, badly.
Cooper's Red, badly.
Dam, slightly.
Early Red Marguerite, very badly.
Hames, slightly.
Horse, moderately.
Red June, slightly.
Jonathon, very badly.
Santa, very badly.
Senator, very badly.
Shockley, very badly.
Thornton's Seedling, slightly.
Winesap, slightly.
Yakor, slightly.

This seems to indicate that spraying with Bord
mixture has no effect upon the disease. Some of
varieties were even more affected this season than
In reviewing the work of the past few seasons, it
be said that the rust is gradually increasing thro
out the orchard. At present there are but few va
ties that have not been at least slightly affected
the rust. While many of the varieties have not
affected so as to show reduced growth, many ot
have received a very serious setback from this caus

The Green Aphis of Apples.—This insect has
very troublesome this season, and spread upon m
varieties not attacked before.

The following varieties have been more or less
fected:

Aikin, badly.
Apple of Commerce, very badly.
Battyani, badly.
Black Ben Davis, very badly.
Bledsoe, slightly.
Benoni, slightly.
Carolina Green, badly.
Cooper's Red, badly.
Cooper's Early, badly.
Early Harvest, slightly.
Elgin Pippin, badly.
Epir, very badly.
Family, badly.
Garvenstein, slightly.
Horse, very badly.
Jeffries' Everbearing, very badly.
Jennings, slightly.
Mammoth Black Twig, very badly.

Moultries, very badly.
Mangum, very badly.
Mamma, slightly.
Noble Savor, badly.
Nickajack, slightly.
Mavarack Sweet, slightly.
Os-zi-vaj, badly.
Pear (or Palmer), badly.
Red Limbertwig, badly.
Rawls Janeton, very badly.
Red Beitigheimer, very badly.
Red Margaret, slightly.
Summer Queen, very badly.
Saxon Priest, badly.
Shockley, slightly.
Senator, very badly.
Summer Cheese, slightly.
Sweet Bough, badly.
Shackleford, badly.
Texas Red, slightly.
Tuscaloosa Seedling, slightly.
Winesap, badly.
Wealthy, slightly.
Yellow English, badly.
Yakor, slightly.

This agrees to some extent with last year's report. There were sixteen varieties attacked this season that were not last, and thirteen varieties that were attacked last year that are free this. As in the case of the rust, the varieties that are resistant to the attack of the insects are becoming fewer every year. The indications are that there are no varieties that we can say are perfectly resistant to the attacks of this insect.

List of Hardy Varieties.—The following have been free from rust, aphis, and leaf spot for the past three

seasons: Hyari Piros, Magyur, Maiden Blush, Metell, and Ponyike. There were eight hardy varieties last year and only five this. Three of the American varieties —Aikin, Babbitt and York Imperial—were slightly attacked with rust. Of the varieties that are not in the above list, but that have made a satisfactory growth, and are in good condition this fall are the following:

Aikin.	Jennings.
Arkansas Black.	Keeskemet.
Babbitt.	Kinnard's Choice.
Battyan.	Limbertwig.
Buncomb.	Mavarack Sweet.
Bradford.	Red Astrachan.
Bledsoe.	Summer Wafer.
Carter's Blue.	Selymes.
Champion.	Yakor.
Epir.	York Imperial.
Elgin Pippin.	Wilalyfi.
Gravenstein.	

The following varieties fruited for the first time this season: Bledsoe, Champion, Red Limbertwig, Thornton's Seedling, and Whalye.

The work with the bearing orchard has been along the line of spraying with Bordeaux mixture as a preventative against summer rot* and other diseases that cause the decay of fruit before maturity. As the first test along the line it was decided to keep the orchard very thoroughly sprayed from early spring until the fruit was ripe. The orchard was sprayed nine times

*We use the term summer rot to denote all the kinds of rot as a class. The one rot very noticeable this season was what is known as black rot (Sphæropsis malorum).

during the summer at the following dates: March 27th, before growth started; April 8th and 25th, May 22nd, June 5th and 22nd, August 9th and 28th. Paris green was used, after the blossoms had fallen, at the rate of eight ounces to fifty gallons of the mixture, which was the same as that used in spraying for apple rust. Care was taken to cover the whole tree very thoroughly, and especially the fruit.

Notes on Varieties.—The varieties that were practically free from rot are: Early Harvest, Hames, Hews' Virginia, Hiley's Eureka, Hubersham Late, Prior's Red, Red June, Summer Red, Thornton's Seedling, Shockley, Stephens' Winter, Winesap.

Varieties only slightly affected by the rot: Ben Davis, Golden Pippin, Horn, Kellageskee, Limbertwig, Red Astrachan, Rome Beauty, Rawls' Janeton, Shannon Pippin, Terry's Winter, Yopp's Favorite.

Varieties which rotted badly: American Golden Russett, Cannon Pearmain, Elgin Pippin, Red Limbertwig, Yellow English.

The growing of apples is a very difficult problem so far South, and without spraying a greater per cent. of the apples are more or less rotten before they are ripe. The orchard was an old one, and has had very little treatment. It was full of all kinds of diseases and insects that had flourished at will.

The work of the fruit season seems to point to the conclusion that by careful selection of varieties, good cultivation, and thorough spraying, good clean apples can be grown here from June until early winter. The old trees this season have made a good, strong, healthy growth.

CHERRIES.

In the spring of 1898 eleven of the leading variet cherries were planted. All of the trees of three o varieties have died. Several more are making a s gle for existence. Four of the varieties have ma good strong growth and seem to be fairly hardy in climate. They are: Deyhouse, Governor Wood, Os mer, and Suda. These varieties all bloomed full gave promise of a heavy fruitage this season, but the fruit was about half grown the bulk of it dro off. Whether this peculiarity is due to the climatic ditions or to the trees not being old enough can n present be determined.

Although cherries can not be recommended for eral planting they should be in the list of the home den for the northern half of the State.

Varieties.	No. of trees set 1898.	No. of trees alive 1901.	General condition in the fall 1901.
Abbasse........	2	1	Fairly strong and vigorous.
Black Tartarian	2	1	Weak and growth poor.
Dyehouse	1	1	Vigorous and strong with a good growth.
Early Richmond	1	0	
English Morello	1	0	
Governor Wood.	2	1	Vigorous, good healthy growth.
Mont. O. King.	2	2	Fairly vigorous, growth small.
Napolean.......	1	0	
Ostheimer......	2	2	Strong and vigorous with a good growth
Suda....	2	2	Strong and vigorous with a good growth.
Wragg.....	2	2	Vigorous, fair growth.

JAPAN WALNUTS.

Trees were set in 1896. They fruited for the first time this season. The nuts are of medium size, borne in large clusters, from six to twelve; shell is a little thicker than that of the English walnut, which they resemble to some extent. The meat is sweet and of good quality, the tree bears early and is a very rapid grower. It makes a handsome tree, having leaves of immense

size. It should be included in the list for home plantin
throughout the State.

PEACHES.

The peach orchard has done well this season, for whil the crop has not been large, nearly all varieties hav borne some fruit. A coöperative experimental orchar was planted in 1898, at the request of a committee c the Association of Agricultural Colleges and Exper ment Stations, for the testing of the geographical limit of the successful cultivation of the different races c peaches. The test consisted of three varieties of thre trees each, of the five races of peaches. The orchar bore a good crop this season, and it is now possible t form some idea of their value.

Alexander.—An old standard sort. Medium, greenisl white, covered with red; flesh white, firm, juicy, swee clingstone. Season first to the middle of June; tree vi orous and productive. A leading early market sort.

Mt. Rose.—Medium to large, white, with red cheel flesh quite firm, juicy, rich, sweet; freestone; a leadir market variety; ripens from the first to the middle c July. Tree vigorous and usually quite productive.

Old Mixon.—This is another old variety. Medium t large, yellowish white, with red cheek; flesh white, ver rich and juicy; freestone; a good shipper, and we known upon the market. Season from the middle to th last of July.

PEENTO RACE.

Varities—**PEENTO, WALDROW,** and **ANGEL.** Th varietieth of this race bloom so early that the blosson are all killed by the frost. See table of blooming perio

NORTH CHINA RACE.

Chinese Cling.—Large, globular, pale yellow; flesh very firm, sweet, rich; a close clingstone; a fine sort for pickling; season first to the middle of July. Tree vigorous and quite productive.

Elberta.—Large to very large, round oval, pale yellow unless fully ripe; flesh pale yellow, firm, rich, juicy, slightly acid; freestone; ripens last of July to first of August. Tree strong, vigorous and very productive. The leading market variety for the South.

Mammie Ross.—Large, round, white, with red cheek, and small red specks over the surface; flesh white, streaked with red under the skin; tender, juicy, sweet; clingstone; season first to the middle of July. Tree vigorous and productive. A promising new variety.

SOUTH CHINA RACE.

Pallas.—Medium, roundish, greenish yellow, with some red over the surface; flesh very white, sweet, rich; freestone; a promising variety for home use and local market; season middle of July. Tree vigorous and very productive. The best variety of the race.

Tabor.—Medium, roundish oblong, pointed, covered with red; flesh white, sweet, juicy; clingstone. Tree vigorous and fairly productive; ripens the last of July.

Honey.—Small, yellowish white, oval, slightly flattened, terminating in a prominent point; flesh very white, sweet, tender, juicy; freestone; season first of July. Trees are fairly vigorous and quite productive.

SPANISH RACE.

Imperial.—Medium to large, roundish oblong, gree ish yellow, covered with reddish spots over the surface flesh white, tender, juicy, sweet; freestone; season las of July. Tree vigorous and quite productive.

Onderkonk.—Small to medium, pale yellow, flesh yel lowish, tender, juicy, good; freestone; ripens about th first of August. Tree vigorous and productive.

Cable's Indian.—Small, roundish, dull grayish red flesh firm, reddish; clingstone; season first of Augus Tree vigorous and productive.

Notes on the Blooming of the Races of Peaches for 1901.

Varieties.	Jan. 22.	Feb. 20.	Feb. 24.	March 4.	March 15.	March 26.	April 1.	April 6.
				PERSIAN	RACE.			
Alexander. ..	....	....	....	....	....	buds showing pink	full bloom..	blossoms falling.
Mount'in Rose	....	....	....	buds swollen..	first blooms.	full bloom..	....	....
Old Mixon....	....	....	....	buds swollen..	first blooms.	full bloom..	....	....
				PEENTO	RACE.			
Peento.	buds showing pink.	blooms fallen..	....	....	Blossoms	all killed by	the frost.	....
Waldrow.....	....	buds showing pink..	blooming...	....	Blossoms	all killed by	the frost.	....
Angel........	....	....	buds showing pink .	full bloom..	Blossoms	all killed by	the frost.	....
				NORTH CH	INA RACE.	all killed by	the frost.	
Chinese Cling.	....	....	....	....	buds pink..	full bloom..	blossoms falling.	....

Notes on the Blooming of the Races of Peaches for 1901.

Varieties.	Jan. 22.	Feb. 20.	Feb. 24	March 4.	March 15.	March 26.	April 1.	April 6.
Elberta	....	....	....	....	buds opening.	full bloom..	blossoms fallen.	....
Mammie Ross.	....	....	....	....	buds pink.	full bloom..	blossoms falling.	....
				SOUTH CHINA RACE.				
Pallas	....	....	....	....	buds pink..	full bloom..	blossoms fallen.	....
Tabor	....	....	....	....	buds pink..	blooming...	blossoms falling.	....
Honey	....	....	buds pink..	buds opening..	full bloom..	blossoms falling.	....	....
				SPANISH RACE.				
Imperial	....	....	....	buds pink..	full bloom..	blossoms fallen.	....	....
Onderkonk	....	....	buds swollen....	buds pink..	full bloom	blossoms fallen.	....	....
Cable's Indian	....	....	....	buds swollen.	blooming...	full bloom..	....	....

The varieties of the Peento race bloom so early that they have no value outside the orange belt. The trees of the South China and Spanish races are strong, vigorous growers, and very productive. Many varieties of these races are suitable for the southern half of the State and coast region for home use and local market. As yet neither race contains any varieties that will compete with the leading market sorts of the Persian or North China races. A variety of peaches containing the vigor and productiveness of the trees of the South China and Spanish races, with the size, color, appearance and general market qualities of the Persian and North China races would be a valuable addition to Southern peach growing.

NOTES ON OTHER VARIETIES OF PEACHES.

Carmen —Large, nearly round, white with red cheek; flesh firm, white, rich, juicy, slightly acid; nearly free; season first to middle of July. Tree vigorous and productive. A promising variety for general planting.

Early Crawford.—An old standard variety; large, oblong oval, rich yellow with a red cheek; flesh yellow, firm, rich, slightly acid; season middle to last of July. Tree vigorous and usually productive. Under favorable conditions this is one of the leading commercial varieties. It wants a rich heavy soil to do its best, for upon poor land it is a shy bearer.

Grey.—Medium to large, rather long and flattened, with a prominent point at the end; skin very smooth, pale yellow, slightly sprinkled with red; flesh thick, firm, rich, sweet; freestone. Tree vigorous and quite productive. It seems to be a promising variety.

Hale's Early.—Medium to large, roundish, greenish white, nearly covered with red; flesh firm, good; cling-

stone; season middle of July. Tree vigorous and v
productive. This is an old market sort, its grea
drawback is its tendency to rot at harvest time.

Matthew's Beauty.—Large, roundish, yellow; f
thick, firm, rich, sweet; freestone; season middle to
of August. Tree vigorous and fairly productive. T
variety follows Elberta and is a promising late sort

McKinney.—Medium to large, yellowish with
cheek; flesh white, firm, juicy, sweet; clingstone; sea
middle to last of June. Tree a strong grower and fa
productive; a promising new variety.

Stump.—Medium to large, round with red che
flesh thick, firm, sweet, juicy; freestone; season firs
August; tree strong, vigorous and productive. An
sort, but still one of the best white varieties in its
son; a good keeper and shipper.

Ovido.—Small to medium, roundish oblong v
prominent point at the end, greenish yellow with
cheek; flesh greenish white, tender, juicy and swe
freestone. Tree a strong grower and very producti

Sneed.—Medium, roundish oval, white with red che
flesh greenish white, juicy; clingstone; season last
May. Tree strong, vigorous and productive. T
earliest peach yet produced.

Triumph.—Medium, yellow, nearly covered with r
flesh yellowish, tender, juicy, good; nearly free; sea
first to middle of June. Tree vigorous and producti
an excellent early peach and a good shipper.

Victoria.—Small to medium, nearly round, pale y
low; flesh pale yellow, sweet, juicy; freestone; sea
first of August. Tree a good grower and quite p
ductive.

OF VARIETIES FOR GENERAL PLANTING IN THE STATE.

short list including some of the best market ve would suggest the following, given in the order ning: Sneed, Triumph, Carmen, Mammie Ross, ain Rose, Chinese Cling, Elberta, Stump, Matth- eauty. For a longer list for home use and local take the above list and add to it Alexander, Mc- , Hale's Early, Early Crawford, Grey, Pallas, Imperial. The last four varieties are suitable r the southern half of the State and coast region.

Notes on the Blooming of Peaches.

Varieties.	March 4.	March 15	March 26.	April 1.	April 6.
Carmen..........	buds swelling.	buds opening.	full bloom.	blossoms falling.	....
Early Crawford ..	....	first blooms.	full bloom.	blossoms falling.	....
Grey	buds swelling.	first blooms.	full bloom.	blossoms falling.	....
Hale's Early.	....	buds pink.	first blooms.	....	full bloom.
Marks.......	....	buds pink.	full bloom.	....	....
Matthew's Beauty	....	first blooms.	full bloom.	blossoms falling.	....
McKinney.	....	buds pink.	first blooms.	full bloom.	blossoms falling.
Stump...........	....	first blooms.	full bloom.	blossoms falling.	....
Ovido	buds opening.	full bloom.	blossoms fallen.	....	....
Reeves......	buds swelling.	first bloom.	full bloom.	blossoms falling.	....
Sneed............	buds swollen	buds opening.	full bloom.	blossoms fallen.	....
Triumph....	....	buds swollen.	blooming	full bloom.	blossoms fallen.
Victoria.........	....	blooming	blossoms fallen.	....	....

PLUMS.

The season has not been a very favorable one for plums. The varieties have fruited very unevenly. This is probably due to the excessive crop of 1900, which left the trees in poor condition. The hailstorm of May 13th did a considerable damage by the hailstones marking the surface of the fruit so as to give it a poor appearance. On account of the freedom from late frost this spring, we were able to get some fruit from the very early blossoming sorts. We give a table of notes on the blossoming period, and general condition of crop, and another tabulation showing the number of trees of each variety, that were set in 1896, the number of trees that have died from 1896 to the fall of 1901, and the number of trees alive at present, with a note as to their general condition.

During the present season a large number of trees have died from some unaccountable cause. For one to have a sucessful plum orchard, a setting of trees must be made every year. So that as fast as one orchard gives out another will be coming on to take its place. (For description of plums and varieties for planting see Bulletin No. 112.)

Notes on the Blooming of Plums 1901.

Varieties.	March 4.	March 9.	March 15.	March 26.	April 6.	April 11.	Condition of crop in 1901.
Abundance, Berger, Botan and Yellow Fleshed Botan.	....	buds showing white.	buds opening.	full bloom.	....	....	About one-half crop.
Burbank....	buds showing white.	buds opening.	full bloom..	fallen.	....	....	Very light.
Blood No. 4	buds opening.	nearly full bloom.	blossoms falling.	....	....	....	Good.
Berckman's	....	buds opening.	full bloom..	falling......	....	....	Light.
Chabot, Babcock, Bailey's Japan, Hattankio, Munson, or Yellow Japan.........	....	buds opening.	full bloom..	fallen.	....	....	Light.
Chas. Downing...	....	....	buds swelling.	buds opening.	nearly full bloom.	blossoms falling.	Full.
Emerson.........	buds opening.	full bloom..	falling......	....	....	....	Full.

Varieties.	March 1.	March 9.	March [illegible]	March [illegible]	April [illegible]	April [illegible]	[illegible] in 1901.
Excelsior		buds opening.	full bloom	fallen.			Very good.
Earliest of All			buds swelling.	buds opening.	full bloom.		Failure.
Golden Beauty			buds swelling	buds opening.	blooming.	blossoms falling.	Very full.
Gold		buds opening.	blooming	fallen.			Fair.
Hale		buds opening.	blooming	fallen.			Failure.
Hawkeye					buds swelling.	blooming	Good.
Kelsey	buds opening.	blooming.	falling.				Light.
Kurr		buds white.	buds opening.	falling			Very good.
Lone Star		buds white.	full bloom	fallen.			Failure.

Notes on the Blooming of Plums in 1901.—Cont'd.

Varieties.	March 4.	March 9.	March 15.	March 26.	April 6.	April 11.	Condition of crop in 1901.
Long Fruited....	....	....	....	buds opening.	full bloom..	falling.	Failure.
Maru	....	....	....	buds swelling.	buds opening	full bloom..	Failure.
Normand.........	....	buds opening.	blooming...	falling......	....	....	Very full.
Milton..........	....	....	buds opening.	blooming...	full bloom..	....	Fair.
Orient..........	....	buds opening.	blooming...	falling	....	....	Tree died before ripening crop.
Pres. Wilder.	....	....	buds opening.	blooming. ..	full bloom..	....	Light.
Red Nagate......	....	....	buds opening.	blooming ..	blossoms falling.	....	Full.
Rockford	....	....	....	....	buds opening.	blooming. ..	Failure.
Satsuma..........	buds opening.	blooming...	blossoms falling.	....	....	....	Good.

Notes on the Blooming of Plums in 1901.—Cont'd.

Varieties	March 4.	March 9.	March 15.	March 26.	April 6	April 11.	Condition of crop in 1901.
Transparent......	....	buds opening.	blooming ..	blossoms falling.	....	....	Very full.
Willard..........	....	....	....	buds opening.	blooming ..	blossoms falling.	Failure.
Wickson..........	buds opening.	blooming.	blossoms falling.	....	....	....	Light
Whitaker.........	....	....	....	buds opening.	blooming...	blossoms fallen.	Good.
Wayland	....	....	buds opening	blooming.	full bloom..	blossoms fallen.	Failure.
Wooten	....	....	buds opening.	blooming ..	full bloom..	blossoms falling.	Full.
Wild Goose.......	....	....	buds white.	buds opening	blooming ...	blossoms fallen.	Full.
Yosebe...........	... .	....	buds white.	buds opening.	blooming ...	blossoms falling.	Light.

Notes on the General Condition of the Orchard.

Varieties. JAPANESE TYPE.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Abundance, Berger, Botan, Yellow Fleshed Botan..........	8	7	1	Strong, vigorous, good growth.
Berckmans.......	2	1	2	In good growing condition.
Burbank...........	4	2	2	Poor growth, trees dying.
Blood No. 3......	2	0	2	
Blood No. 4.....	2	2	0	Making a good growth.
Chabot, Babcock, Baily, Hattankio, Munson, Yellow Japan...........	11	4	7	The few trees left are in good condition.
Hale.............	3	3	0	Very strong and vigorous.
Kelsey...........	2	1	1	Tree in fair condition.
Kerr.............	3	2	1	Quite strong and vigorous.
Long Fruited.....	2	0	2	
Maru.............	2	0	2	

...es on the General Condition of the Orchard.—Cont'd.

...rieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
...nd.........	2	2	0	Trees in good condition.
....	2	0	2	
...ne, ... Nagate	5	3	2	Strong and healthy trees.
...a..........	2	1	1	Last tree slowly dying.
...d	2	0	2	
...e....	1	1	0	In very good condition.
Totals.. ... ...ERICAN ...TYPE.	55	29	26	
...eye	2	0	2	
...ord.... ...	2	1	1	Making a struggle to live.
...r..........	2	0	2	
...	2	0	2	
Totals...... ...D GOOSE ...TYPE.	8	1	7	
...s Downing.	2	1	1	Making good growth.

Notes on the General Condition of the Orchard.—Cont'd.

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Milton..........	2	2	0	In good condition.
Miner............	2	0	2	
President Wilder.	2	1	1	Making good, strong growth.
Whitaker........	2	1	1	Making fair growth.
Wild Goose.......	2	1	1	Growth very poor.
Wooten.........	2	2	0	Small growth.
Totals..	14	8	6	
WAYLAND TYPE.				
Golden Beauty...	2	2	0	Very strong and vigorous.
Wayland.........	2	1	1	Last tree nearly dead.
Totals..	4	3	1	
CHICASAW TYPE.				
Emerson..........	2	2	0	Making a steady growth.
Lone Star........	2	2	0	Only a fair growth.
Transparent.....	1	1	0	Vigorous growth.

Notes on the General Condition of the Orchard.—Cont'd.

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Totals......	5	5	0	
HYBRID PLUMS				
Gold.....	2	2	0	Making good, strong growth.
Excelsior..... ...	2	2	0	Vigorous and strong.
Wickson	2	1	1	Making very poor growth.

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By J. F. DUGGAR.

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THE FLORA OF THE METAMORPHIC REGION OF ALABAMA.

BY F. S. EARLE.

The following list of the ferns and flowering plants of
e Metamorphic Region of Alabama is based on the
llections in the herbarium of the Alabama Polytechnic
stitute at Auburn. The Alabama material in this
rbarium was secured as follows: First, a few plants
llected prior to 1895 by Dr. P. H. Mell and his assist-
ts. (The bulk of this earlier material was destroyed
fire); second, a few plants collected during the Fall
1895 by Dr. L. M. Underwood; third, plants collected
ring the Spring and Summer of 1896 by L. M. Under-
od and F. S. Earle; fourth, plants collected during
e Fall of 1896, during 1897, and the Spring and Sum-
er of 1898 by C. F. Baker and F. S. Earle; fifth, plants
llected from the Fall of 1898 to the Summer of 1901 by
S. Earle and Mrs. F. S. Earle. Prior to 1897 atten-
n had been devoted mainly to the fungi, flowering
ants being taken only incidentally. Prof. Baker first
ggested the systematic collection of the flowering
ants, and the greater part of the species enumerated
low were taken during the period of his residence at
iburn.

As Dr. Charles Mohr was known to be working on a
ra of Alabama, the collections made prior to mid-
mmer of 1897 were all sent to him for determination,
d he was permitted to retain a full set, including all
iques, for his own herbarium. These plants are fre-
ently referred to in his recent work on The Plant Life
Alabama that was published first by the United States
epartment of Agriculture as Volume 6, of the Con-

tributions from the National Herbarium (issued July 31, 1901), and later (October, 1901), was reissued as a report from the Alabama Geological Survey. After midsummer of 1897 Dr. Mohr became so occupied in the preparation of the manuscript for this great work that at his request the sending of plants was discontinued, except as he occasionally asked for material in some special group. The later collections have been determined by Dr. J. K. Small, Mr. G. V. Nash, Dr. Edward L. Greene and other specialists, and by the writer, who has recently had an opportunity to compare some of the more doubtful material with the rich collections in the herbarium of the New York Botanical Garden. Some fifty species are reported by Dr. Mohr of our collecting that are not represented in the harbarium of the Polytechnic Institute; or at least are not represented under the name by which Dr. Mohr reports them. These species are included in this list, Dr. Mohr being cited in each case as the authority. These specimens will be found either in the herbarium of Alabama plants deposited by Dr. Mohr at the State University at Tuscaloosa, or in his private herbarium, which is now incorporated with the National Herbarium at Washington. In part, at least, these species represent uniques that did not chance to be again collected by us. There are, however, too many to be wholly accounted for in this way, and it seems probable that some of them represent cases where Dr. Mohr found occasion to change his original determination of the specimens. It has not been possible to trace these cases, for since the publication of Dr. Mohr's work I have not had access to the collections. It has seemed best to include these names, but with this word of warning as to the possibility of error through including two determinations for the same plant.

It so chanced that Dr. Mohr did very little collecting in that part of the State covered by this list. He, however, made one visit to the rugged mountainous region in Clay county and secured a number of plants that were not taken by us. A few plants have also from time to time been collected in this region by various members of the State Geological Survey. Fifty-two plants from these sources are recorded by Dr. Mohr from this region that do not appear in our collections. These are included in this list, the proper credit being given. It is probable that the specimens representing them are all in the herbarium at Tuscaloosa.

The Metamorphic region of Alabama as mapped by the State Geological Survey, is a triangular area lying on the eastern side of the State. It extends from near the southeast corner of Lee county at a point nearly opposite Columbus, Ga., northerly along the State line for about a hundred miles to a point in the northern part of Cleborne county. From this point the second side of the triangle extends southwestwardly for about the same distance, to a point in Chilton county, some three miles east of the line of the Louisville & Nashville railroad, and from here another hundred miles east-southeast to the point of beginning. This area comprises the southernmost extension of the Appalachian mountain system. It is underlaid by granite and other metamorphic rocks which exert their usual influence on the topography, giving high, rugged hills and frequent exposures of bare rock. There are, however, few vertical or overhanging cliffs, such as are frequent to the north and west in the region underlaid by the coal measures. The soil varies from a light and rather coarse sandy loam to the red hornblendic soil so characteristic of the Piedmont region of Georgia. In many places it is much incumbered with angular fragment of quartz and other hard resistant

rocks. The original timber growth varied from almost pure long leaf pine forests at the southern border and along the bluffs of the Tallapoosa, to pure hardwood forests on the richer areas, especially to the northward. The greater part of the area was, however, a mixed forest of hardwoods and long or short leaf pines. The region is divided into nearly equal parts by the Tallapoosa river, the portion to the south and east being the high, broad ridge that forms the divide between this stream and the Chattahoochee. The northwestern portion forming the divide between the Tallapoosa and the Coosa is more rugged and broken, and in the Talladega Mountains reaches the highest elevations to be found in the State (2,300 feet). This is one of the most interesting parts of the State, and deserves much more extended study. It was visited only once by Dr. Mohr and once by the writer.

This metomorphic region is of special interest botanically since it constitutes the southernmost extension of the Carolina Life Zone. Many of the characteristic plants of the Appalachian system find here their most southerly stations while mingling with these northern representatives are many plants that have pushed up from the Gulf region. This mingling of the two floras accounts for the large number of species found. Of the 1146 species and varieties ennumerated in the following list, 94 are new to the State, and are not included in Dr. Mohr's work. These are indicated by an asterisk (*). There are 76 others that were previously known in Alabama only from the northern part of the State. These represent an extension of the known range in the State to the southward, and are marked by a dagger (†). There are also 167 species that represent a northerly extension of the known range within the State. These are indicated by a double dagger (‡). The larger number

iis latter class is accounted for by the fact that Au-
i, where the greater part of the collecting was done,
i the extreme southern border of the metamorphic
on. In fact the more sandy lands of the central
belt extend at one point to within half a mile of the
ege building. All the plants collected in the neigh-
ood of Auburn have been included in the list
ther they were taken from one side or the other of
rather vaguely defined line. While most of the
ts that are marked with the double dagger are un-
otedly characteristic of the central pine belt rather
i of the metamorphic hills; still it is probable that
ost or quite all of them are to be found at some point
he more sandy lands that are clearly within this re-
proper.

he ecological relations of the flora have not in all
s been critically studied. The topographical features
he country will, of course, limit the plant societies
ormations. The following situations have each a
e or less clearly marked flora, and the brief
on habitat following each species in the list
, in most cases, indicate the nature of the locality
re the plant should be sought. Beginning with the
rophytes we may distinguish, first, the plants of the
dly moving streams with which the region is abund-
y supplied. Second, plants of pools and ponds. Ponds
not frequent, those found being mostly artificial.
rd, marsh plants, inhabiting certain open miry
es, and the open boggy banks of streams. Such
is are restricted and rather infrequent, but certain
its are found only in such localities. Fourth, swamp
its of the poorly drained timbered land along
ams. In clay land there are likely to be "alder
mps," the prevailing growth being alder (*Alnus ru-*

gosa) and willow (*Salix nigra*) frequently with a dense undergrowth of cane (*Arundinaria tecta*). In sandy land swamps are more often "bay heads" with a prevailing growth of white bay (*Magnolia Virginiana*), red bay (*Persea pubescens*) and maple (*Acer rubrum.*) In places these "bay heads' 'develop into "Sphagnum bogs," where the ground is carpeted with peat moss (*Sphagnum sp.*). Each of these varieties of swamp has its own peculiar association of plants. Of mesophyte associations we have, 1st, the plants of the better drained creek and river bottoms, and, 2nd, the moister and richer northern slopes of the uplands. Such locations are usually heavily timbered mostly with hard woods, but occasionally mixed with loblolly pine (*Pinus Iaeda*) in the lowlands, and with the short leaf pine (*Pinus echinata*) in the uplands. These associations are rich in the number of species and include most of the more northern types. The plants from the Gulf region are to be sought on the dryer, more sandy uplands, and in the sandy bay heads and Sphagnum bogs. More or less distinctly zerophytic associations occupy the greater part of the upland area. Here we may distinguish. 1st, plants of the dry hardwood forests. These are usually found on the south slopes of the red clay hills; 2nd, plants of mixed woods, including long or short leaf pines and hard woods. This type of forest is the prevailing one over a large part of the entire region; 3rd, plants of the long leaf pine (*Pinus palustris*) forests. These are confined to the extreme southern border and to a strip along the hills bordering the Tallapoosa river. A large number of southern species are found in this long leaf pine association; 4th, an extremely zerophytic association found on exposed granite outcrops. Occasionally granite outcrops occur where they are somewhat moisted

y a stream or spring and here we find still a different ssociation of plants. Besides these which may be conidered as constituting the natural plant covering of he region we have other associations whose advent is letermined by the presence of man. Among these we nay distinguish, 1st, the weeds of cultivated fields and ardens; 2nd, the weeds of pastures, roadsides and waste laces; 3rd, the plants of abandoned or "turned out" ields, and, 4th, the plants of the second growth woods hat ultimately reclothe these abandoned fields. The lobolly pine (*Pinus Taeda*) usually plays the leading part n this forestization, though with it are associated sweet um (*Liquidambar*) black gum (*Nyssa sylvatica*), perimmon (*Diospyros*) and occasional individuals of nuerous other trees.

OPHIOGLOSSACEAE.

‡Botrychium biternatum (Lam.) Underw.
A single specimen, upland pasture, Auburn, (in Underwood Herbarium.)

Botrychium obliquum Muhl.
Frequent, creek-bottom woods.

Botrychium Virginianum (L.) Sw.
Occasional, creek-bottom woods.

Ophioglossum crotalophoroides Walt.
Occasional, grassy creek-bottom pastures.

OSMUNDACEAE.

Osmunda cinnamomea L.
Common, swampy places.

Osmunda regalis L.
Common, swamps.

POLYPODIACEAE.

†Adiantum pedatum L.
Moist, shaded hillsides, river hills, Tallapoosa county.

Asplenium Bradleyi, D. C. Eaton.
Clay county (Mohr's Plant Life.)

Asplenium Filix-foemina (L.) Bernh.
Common, moist woods, variable.

Asplenium parvulum Mart. & Gall.
Clay county (Mohr's Plant Life.)

Asplenium platyneuron (L.) Oakes.
Common, rocky hillsides, granite outcrops.

Asplenium Trichomanes L.
Clay county (Mohr's Plant Life.)

Cheilanthes lanosa (Michx.) Watt.
Common, cliffs, granite outcrops.

Dryopteris Floridana (Hook.) O. Kuntze.
A single station, a swamp 6 miles south of Auburn, Lee co.

Dryopteris marginalis (L.) A. Gray.
Clay county (Mohr's Plant Life.)

†Dryopteris Noveboracensis (L.) A. Gray.
Clay county, creek bottoms.

‡Dryopteris Thelypteris (L.) A. Gray.
Occasional, creek bottoms, moist rich woods.

‡Onoclea sensibilis L.
Occasional, creek bottoms, clay land.

†Phegopteris hexagonoptera (Michx.) Fee.
Occasional, moist woods, creek bottoms.

Polypodium polypodioides (L.) A. S. Hitchcock.
Common, rocks, tree trunks.

Polystichum acrostichoides (Michx.) Schott.
Common, rocky hillsides in woods.

‡Pteridium aquilinum pseudocaudatum Clute.
Common, dry pine woods.

†Woodsia obtusa (Spreng.) Torr.
Frequent, rocky banks, granite outcrops.

Woodwardia areolata (L.) Moore.
Common, creek bottom swamps.

oodwardia Virginica (L.) Smith.
A single collection, Auburn.

LYCOPODIACEAE.

opodium pinnatum (Chapm.) Lloyd & Underw.
Frequent, sphagnum bogs.

SELAGINELLACAE.

aginella apus (L.) Spring.
Frequent, on the ground in swamps.

PINACEAE.

niperus Virginiana L.
Frequent, especially along roadsides.

us echinata Mill.
The short leaf pine; common in mixed upland woods.

us palustris Mill.
The long leaf pine; the prevailing timber on sandy lands, Lee county, and on dry rocky ridges bordering the Tallapoosa River.

us Taeda L.
Loblolly pine, old field pine, swamp pine; common, swamps and uplands, especially as a second growth in abandoned fields.

TYPHACEAE.

pha latifolia L.
Frequent, marshy places and shallow ponds and ditches.

SPARGANIACEAE.

arganum androcladum (Engelm.) Morong.
Occasional, marshy places.

ALISMACEAE.

agittaria latifolia Willd.
Common, marshes and ditches.

‡Sagittaria pubescens Muhl.
A single collection, swamp in river hills, Elmore county.

POACEAE.

Agrostis Elliottiana Schult.
Common, dry open places.

Agrostis hyemalis (Walt.) B. S. P.
Common, dry open places.

‡Agrostis intermedia Scribn.
A single collection, Auburn.

Aira caryophylla. L.
Common, dry open places.

Alopecurus geniculatus L.
Occasional, wet open places.

Andropogon argyraeus Schultes.
Common, dry woods and fields.

*Andropogon corymbosus (Chapm.) Nash.
Occasional, wet swampy places.

‡Andropogon Elliottii Chapm.
Occasional, dry woods.

Andropogon furcatus Muhl.
Infrequent, dry woods and roadsides.

‡Andropogon glomeratus (Walt.) B. S. P.
Frequent, wet swampy places. A smaller form with r
panicles occurs in moist, upland woods.

Andropogon scoparius Michx.
Very common and variable. As here recognized it pr
includes more than one species.

Andropogon Tracyi Nash.
Frequent, sandy uplands fields or thin woods.

Andropogon Virginicus L.
Very common, especially in old fields. (Broom sedge). Va

‡Anthaenatia villosa Beauv.
Occasional, moist sandy lands, south of Auburn.

Aristida lanosa Muhl.
Frequent, dry sandy lands, south of Auburn.

Aristlda purpurascens Poir.
A single collection, Auburn.

rhenatherum elatius (L.) Beauv.
A single collection, Auburn.

rundinaria tecta (Walt.) Muhl.
Common, creek bottom swamps (Cane.)

romus unioloides (Willd.) H. B. K.
Occasional, fields, roadsides, etc. (escaped.)

Brachyelytrum erectum (Schreb.) Beauv.
Occasional, rich upland woods.

mpulosus aromaticus (Walt.) Scrib.
Gold Hill, Lee county (Mohr's Plant Life.)

priola Dactylon (L.) O. Kuntze.
Abundantly introduced (Bermuda grass.)

enchrus echinatus L.
Occasional, sandy fields.

aetochloa glauca (L.) Scribn.
Common, cultivated fields.

haetochloa perennis (Curtiss) Bicknell.
A single collection, Auburn.

rysopogon avenaceus (Michx.) Benth.
Common, upland woods and open places.

hrysopogon nutans (L.) Benth.
Common, upland woods and open places.

nna arundinacea L.
Occasional, wet swampy places.

actyloctenium Aegypticum (L.) Willd.
Common, cultivated fields.

anthonia sericea Nutt.
Frequent, dry woods and open places, clay or sand.

Danthonia spicata (L.) Beauv.
Rocky hillsides, clay land, north of Auburn.

atonia filiformis (Chapm.) Vasey.
Frequent, dry woods.

atonia nitida (Spreng.) Nash.
Common, dry woods.

Eatonia Pennsylvanica (D C.) A. Gray.
Dry open hillsides, Auburn.

Eatonia Pennsylvanica (D C.) A. Gray.
A single collection, Auburn, creek bottom woods.

Echinochloa Crus-galli (L.) Beauv.
Occasional, gardens and barnyards.

Eleusene Indica (L.) Gaertn.
Common, cultivated fields.

*Elymus galbriflorus (Vasey) Scribn. & Ball.
Occasional, dry woods.

Elymus strictus Willd.
Lee county. Earle & Baker (Mohr's Plant Life.)

Elymus Virginicus L.
Lee County, (Mohrs Plant Life.)

‡Eragrostis hirsuta (Michx.) Nash.
Frequent, dry, open places.

Eragrostis major (L.) Host.
Common, cultivated fields.

Eragrostis pectinacea (Michx.) Steud.
Common, dry open places.

Eragrostis Purshii Schrad.
Occasional, cultivated fields.

‡Eragrostis refracta (Muhl.) Scribn.
Common, dry open places.

Erianthus alopecuroides (L.) Ell.
Common, upland woods, usually on clay.

*Erianthus compactus Nash.
Common, upland woods, usually on clay.

*Erianthus contortus Ell.
Common, poor usually sandy woods.

Festuca nutans Willd.
Frequent, moist woods.

*Festuca obtusa Spreng.
A single collection, Chambers county.

Festuca octoflora Walt.
Common, dry open places.

Festuca octoflora aristata (Torr.) Dewey.
Lee county, Earle & Baker (Mohr's Plant Life.)

Festuca sciurea Nutt.
Lee county, Earle & Baker (Mohr's Plant Life.)

Festuca Shortii Knuth.
Lee county, Earle & Baker (Mohr's Plant Life.)

Gymnopogon ambiguus (Michx.) B. S. P.
Frequent, dry sandy woods.

Iomalocenchrus Virginicus (Willd.) Britt.
Frequent, wet swampy places.

'anicularia nervata (Willd.) O. Kuntze.
Occasional, cultivated fields.

Ielica mutica Wall.
Frequent, upland woods.

Iuhlenbergia capillaris (Lam.) Trin.
Frequent, dry open places.

Muhlenbergia diffusa Schreb.
A single collection, Auburn.

)plismenus hirtellus (L.) R. & S.
Occasional, moist sandy places in shade.

'anicularia nervata (Willd) O. Kuntze.
Common, wet shady places.

'anicum agrostoides Muhl.
Clay county (Mohr's Plant Life.)

Panicum Alabamense Ashe.
Collected once, Auburn, swamp. This is very close to P. lucidum Ashe, and is probably identical with that species.

'anicum angustifolium Ell.
Very common, dry upland woods and roadsides.

Panicum Auburne Ashe.
Collected once, Auburn, uplands. This is probably only a small form of P. sphaerocarpon. Ell.

'anicum barbulatum Michx.
Common, wet, swampy woods.

Panicum Rogueanum Ashe.
Collected once, Auburn, uplands.

'anicum clandestinum L.
Occasional, alder swamps, clay land.

'anicum commutatum Schult.
Common, dry sandy uplands, roadsides, old fields and thin woods; often forming a dense sod.

'anicum depauperatum Muhl.
Common, dry uplands.

Panicum dichotomum L.
Very common, moist or dry land.

Panicum Earlei Nash.
Occasional, sandy swamps.

Panicum elongatum Pursh.
Occasional, damp places.

*Panicum hians Ell.
Frequent, low, wet places.

Panicum lanuginosum Ell.
Collected once, Chambers county.

‡Panicum laxiflorum Lam.
Very common, moist places. A form has been called P. cari cifolium Scribn.

Panicum lucidum Ashe.
Frequent, wet places, sphagnum bogs, etc.

Panicum melicarium Michx.
Lee county, Earle & Baker (Mohr's Plant Life.)

Panicum microcarpon Muhl.
Frequent, moist uplands.

*Panicum mutabile Scribn. & Merrill.
Occasional, dry woods. These specimens have been deter mined as P. Joori Vasey.

Panicum neuranthum Greiseb.
Collected once, Auburn.

Panicum oliganthes Schult.
Occasional, sandy uplands.

Panicum Porterianum Nash.
Common, rich uplands.

Panicum pseudopubescens Nash.
Very common, dry uplands.

‡Panicum pubifolium Nash.
Frequent, sandy uplands.

Panicum pyriforme Nash.
Lee county, Earle & Baker (Mohr's Plant Life.)

Panicum Ravenelii Scribn. & Merrill.
Frequent, sandy uplands.

Panicum rostratum Muhl.
Common, uplands.

Panicum scoparium Lam.
Common, open sandy creek bottoms.

†Panicum Scribnerianum Nash.
Collected once, Auburn.

Panicum sphaerocarpon Ell.
Frequent, ditch banks and uplands.

Panicum Texanum Buckl.
Common, fields, introduced.

Panicum trifolium Nash.
Frequent, swamps.

‡Panicum verrucosum Muhl.
Common, shaded swamps.

Panicum virgatum L.
Common and variable, uplands and creek bottoms.

‡Panicum Webberianum Nash.
Common, dry exposed uplands, clay or sand.

*Panicum Yadkinensis Ashe.
Collected once, creek bottom, Auburn.

*Paspalum augustifolium Le Conte.
Frequent, upland woods, often confused with P. *laeve*. Michx.

Paspalum Boscianum Fleugge.
Common, cultivated fields.

Paspalum ciliatifolium Michx.
Common, upland woods.

Paspalum compressum (Sw.) Nees.
Common, wet pastures (Carpet grass.)

‡Paspalum dilatatum Poir.
Frequent, wet pastures and roadsides.

‡Paspalum distichum L.
Occasional, wet creek bottoms.

‡Paspalum Floridanum Michx.
Occasional, sandy uplands.

Paspalum laeve Michx.
Occasional, upland woods.

‡Paspalum longipedunculatum Le Conte.
Occasional, sandy uplands.

Poa annua L.
Common, dooryards, pastures and waste places.

Poa autumnalis Muhl.
Frequent, swampy woods.

†Poa pratensis L.
Occasional, roadsides and open woods.

‡Sorghum Halapense (L.) Pers.
Frequent, fields and waste places, (Johnson grass.)

Sporobolus asper (Michx.) Kunth.
Frequent, sandy woods and roadsides.

Sporobolus Indicus (L.) R. Br.
Common, pastures and door-yards, (Smut grass.)

Sporobolus punceus (Michx.) Kunth.
Frequent, dry sandy woods south of Auburn.

Stipa avenacea L.
Frequent, upland woods, sand or clay.

‡Syntherisma fimbriatum (Link) Nash.
Common, cultivated fields, (Crab grass.)

‡Syntherisma villosum Walt.
Occasional, cultivated fields.

Tricuspis seslerioides (Michx.) Torr.
Common, upland woods and open places.

Tripsacum dactyloides L.
Frequent, ditch banks and borders of moist fields.

*Trisetum aristatulum (Scribn. & Merrill) Nash.
Dry clay woods, Tallapoosa county.

†Trisetum Pennsylvanicum (L.) Beauv.
Frequent, moist woods.

Uniola latifolia Michx.
Frequent, rich upland woods.

Uniola laxa (L.) B. S. P.
Collected once, Auburn.

Uniola longifolia Scribn.
Frequent, upland woods and creek bottoms.

CYPERACEAE.

Carex Atlantica Bailey.
Frequent, rich woods.

Carex cephalophora Muhl.
Frequent, dry wooded hillsides.

ex crinita Lam.
A single collection, Auburn.

ex debilis Michx.
Frequent, wet woods.

ex granularis Muhl.
Lee county, Earle & Baker (Mohr's Plant Life.)

arex gynandra Schw.
Occasional, upland woods, Lee county, Tallapoosa county.

ex interior Bailey.
Lee county, Earle & Baker (Mohr's Plant Life.)

ex intumescens Rudge.
Frequent, swamps and ditch banks.

ex laxiflora Lam.
Common, upland woods.

ex laxiflora varians Bailey.
Lee county, Earle & Baker (Mohr's Plant Life.)

ex leptalea Wahl.
Common, swamps.

ex lurida Wahl.
Frequent, swamps and marshy places.

arex nigro-marginata Schw.
Frequent, dry rocky hillsides and granite outcrops. The most southerly known station for this rare *Carex.*

ex oblita Steud.
Frequent, swamps.

arex ptychocarpa Steud.
Frequent, creek bottom swamps.

ex sterilis Willd.
Frequent, swampy creek bottoms.

ex stipata Muhl.
Frequent, wet open places.

arex tenera Dewey.
Common, rich woods.

arex Texensis (Torr.) Bailey.
Occasional, Auburn.

ex triceps Michx.
Common dry upland woods.

Carex verrucosa Muhl.

Frequent, swamps, matures in midsummer. (=C. glaucescens Ell. of Mohr's Plant Life.)

Carex vulpinoidea Michx.

Common, wet places, ditch banks, etc.

Cyperus cylindricus (Ell.) Britt.

Frequent, sandy fields, etc.

Cyperus echinatus (Ell.) Wood.

Common, sandy uplands.

Cyperus filiculmis Vahl.

Frequent, sandy lands.

Cyperus Haspan L.

Frequent, marshy grass lands.

Cyperus Lancastriensis Porter.

Occasional, Lee county, Tallapoosa county.

Cyperus ovularis (Michx.) Torr.

Frequent, dry uplands.

Cyperus pseudovegetus Steud.

Frequent, swampy places.

Cyperus retrofractus (L.) Torr.

Common, dry sandy uplands.

Cyperus rotundus L.

Nut grass, a garden pest, locally abundant.

Cyperus stenolepis Torr.

Lee County, Earle & Baker. (Mohr, Plant Life.)

Cyperus strigosus L.

Common, fields and marshy places.

Eleocharis obtusa Schultes.

Common, marshy places.

Eleocharis prolifera Torr.

Occasional, marshy places.

Eleocharis tuberculosa (Michx.) R. & S.

Occasional, marshy places.

Fimbristylis autumnalis (L.) R. & S.

Common, marshy places and sandy fields.

*Fimbristylis laxa Vahl.

A single collection, Auburn.

*Fuirena squarrosa Michx.
Common, marshy. places.

‡Fuirena squarrosa hispida (Ell.) Chapm.
Frequent, sphagnum swamps, etc.

‡Hemicarpa micrantha (Vahl) Britt.
Frequent, marshy places.

Kyllinga pumila Michx.
Common, wet places.

Rynchospora axillaris (Lam.) Britt.
Occasional, marshy places.

‡Rynchospora corniculata (Lam.) A. Gray.
Frequent, borders of ponds, etc.

Rynchospora cymosa Ell.
Frequent, marshy places.

Rynchospora filifolia Torr.
A single collection, Auburn.

Rynchospora glomerata (L.) Vahl.
Occasional, marshy places.

Rynchospora golmerata paniculata (A. Gray) Chapm.
Common, moist or dry open places, roadsides, etc.

*Rynchospora microcephala Britt.
A single collection, Auburn.

*Rynchospora patula A. Gray.
A single collection, Macon's Mill, Lee county.

Rynchospora rariflora Ell.
Occasional, marshy places.

‡Scirpus Eriophorum Michx.
Occasional, wet places, clay land.

Scleria ciliata Michx.
Frequent, upland woods.

Scleria oligantha Michx.
Frequent, upland woods.

*Scleria pauciflora Muhl.
A single collection, Auburn.

‡Scleria pauciflora glabra Chapm.
Frequent, moist woods.

Scleria triglomerata Michx.
Frequent, upland woods.

Stenophyllus capillaris (L.) Britt.
Frequent, sandy fields and marshy places.

PALMACEAE.

Rhapidophyllum hystrix (Fraser) Wendl. & Drude.
Rare, swamps, Lee county, clay and sand.

†Sabal Adansonii Guerns.
Rare, swamps, Lee count, in sand.

ARACEAE.

Arisaema quinatum (Nutt.) Schott.
Occasional, swamps and wet woods.

Arisaema triphyllum (L.) Torr.
Occasional, wet woods.

Orontium aquaticum L.
Clay county (Mohr's Plant Life.)

Peltandra Virginica (L.) Kunth.
Occasional, swamps and wet woods.

MAYACAEAE.

‡Mayaca Aubletii Michx.
Frequent, sandy swamps, usually with sphagnum.

XYRIDACEAE.

‡Xyris ambigua Beyrich.
A single collection, Auburn.

Xyris Caroliniana Walt.
Frequent, sandy borders of ponds, etc.

Xyris communius Kunth.
Lee county, J. D. Smith (Mohr, Plant Life.)

Xyris flexuosa Muhl.
Occasional, sandy swamps.

Xyris iridifolia Chapm.
Occasional, sandy swamps.

Xyris torta Smith.
Frequent, sandy swamps.

BROMELIACEAE.

‡Tillandsia usneoides L.
Occasional on trees in creek bottoms. All killed by the "freeze" of February, 1899.

COMMELINACEAE.

Commelina communis L.
Escaped, ditch banks, Auburn.

Commelina erecta L.
Frequent, dry hillsides.

Commelina hirtella Vahl.
Frequent, swampy creek bottoms.

‡Tradescantia hirsuticaulis Small.
River hills, Elmore county; also sandy woods, Lee county.

Tradescantia montana Shuttlw.
Rich upland woods, Clay county, Coosa county.

Tradescantia reflexa Raf.
Frequent, dry rocky hillsides, granite outcrops.

JUNCACEAE.

Juncoides echinatum Small .
Frequent, wooded hillsides.

Juncus acuminatus Michx.
Frequent, wet open places.

Juncus acuminatus debilis (A. Gray) Engelm.
Frequent, wet open places.

Juncus Canadensis A. Gray.
Occasional, Auburn.

‡Juncus diffusissimus Buckl.
Shallow pool in swamp, Auburn.

*Juncus Dudleyi Wiegand.
Frequent, dry woods and roadsides.

Juncus effusus L.
Frequent, wet, open places.

Juncus marginatus Rostk.
Frequent, wet, open places.

Juncus marginatus aristulatus (Michx.) Coville.
Common, wet open places.

‡Juncus polycephalus Michx.
Frequent, wet, open places.

‡Juncus repens Michx.
Sandy borders of ponds, in or out of water.

*Juncus robustus (Englm.) Coville.
A single collection, Auburn.

‡Juncus scripoides Lam.
Common, wet open places.

Juncus setaceus Rostk.
Common, wet open places.

Juncus tenuis Willd.
Common, especially along paths and woods roads.

Juncus Torreyi Coville.
Lee county, Earle & Baker (Mohr, Plant Life.)

Juncus trigonocarpus Steud.
A single collection, Auburn.

LILIACEAE.

‡Aletris farinosa L.
Occasional, borders of sandy swamps.

Allium mutabile Michx.
Common, creek bottoms, clay land, often in fields.

Allium veneale L.
Introduced, fields, etc., Auburn.

*Chamaelirium obovale Small.
Occasional, rich upland woods.

Chrosperma muscaetoxicum (Walt.) O. Kuntze.
Rare, taken once near Auburn.

Lilium Carolinianum Michx.
Occasional, rich upland woods.

Medeola Virginica L.
Occasional, moist, rich woods.

Melanthium Virginianum L.
Rare, taken once near Auburn.

Nothoscordium bivalve (L.) Britt.
(=Allium stratum.)
Common, dry rocky hillsides, granite outcrops, etc.

Polygonatum biflorum (Walt.) Ell.
Frequent, moist rich woods and creek bottoms.

†Polygonatum commutatum (R. & S.) Dietr.
Occasional, moist, rich woods, creek bottoms, etc.

*Triantha glutinosa (Michx.) Baker.
(=Tofeldia glutinosa Michx.)
Occasional, open marshy places.

Trillium stylosum Nutt.
Frequent, rich, moist woods, uplands or creek bottoms, usually on clay

Trillium Underwoodii Small.
Common, wooded creek bottoms, clay land north of Auburn, the type locality. A taller form with less conspicuously mottled shorter leaves occurs in sandy swanmps south of Auburn.

Uvularia perfoliata L.
Frequent, rich, moist woods, uplands or creek bottoms.

Uvularia sessilifolia L.
Frequent, rich, moist woods, creek bottoms, etc.

Vagnera racemosa (L.) Morong.
Frequent, rich, moist woods, creek bottoms, etc.

Yucca filamentosa L.
Occasional, roadsides and waste places.

SMILACACEAE.

Smilax Bona-nox L.
Occasional, fence rows and thickets.

*Smilax cinnamomifolia Small.
In dry woods and old fields.

Smilax ecirrhata (Engelm.) Wats.
Frequent, rich upland woods.

Smilax glauca Walt.
Upland woods and old fields.

†Smilax herbacea L.
Frequent, rich woods.

Smilax hispida Muhl.
Frepuent, thickets, etc.

‡Smilax lanceolata L.
Frequent, moist thickets. (Jackson vine.)

‡Smilax laurifolia L.
Common, swamps (Bamboo vine.)

Smilax Pseudo-China L.
Occasional, fence rows and thickets.

Smilax pumila Walt.
Frequent, dry hillsides.

Smilax rotundifolia L.
Common, fence rows and thickets.

‡Smilax Walteri Pursh.
Occasional, swamps, sandy land.

AMARYLLIDACEAE.

‡Atamosco Atamasco (L.) Greene.
Common, creek bottoms.

Hymenocallis occidentalis Kunth.
Rare, sandy creek bottoms.

Hypoxis hirsuta (L.) Coville.
Common, upland woods.

Manfreda Virginica (L.) Salisb.
(=Agave Virginica L.)
Frequent, dry rocky hillsides and granite outcrops.

DIOSCOREACEAE.

Dioscorea villosa L.
Common, a climbing vine in rich woods.

IRIDACEAE.

Gemmingia Chinensis (L) O. Kuntze.
Occasional, roadsides, etc.

†Iris cristata Ait.
Long-leaf pine woods, Tallapoosa county.

‡Iris verna L.
Long leaf pine woods, Tallapoosa county.

Sisyrinchium Carolinianum Bicknell.
Frequent, upland woods.

*Sisyrinchium flaccidum Bicknell.
Occasional, banks of streams.

‡Sisyrinchium grammoides Bicknell.
Frequent, upland woods.

BURMANNIACEAE.

‡Burmannia biflora L.
A single collection, swampy creek bottoms, sandy land.

ORCHIDACEAE.

Achroanthes unifolia (Michx.) Raf.
Rare, creek bottom swamps.

†Corallorhiza odontorhiza (Willd.) Nutt.
A single collection, Auburn.

Cypripedium parviflorum Salisb.
Clay county (Mohr's Plant Life).

Gyrostachys cernua (L.) O. Kuntze.
Frequent, moist places, creek bottoms, etc.

Gyrostachys gracilis (Bigel.) O. Kuntze.
Common, dry pine woods.

*Gyrostachys simplex (A. Gray) O. Kuntze.
A single collection, Auburn, dry pine woods.

*Gyrostachys vernalis (Engelm.) Small.
Occasional, pine woods.

Habenaria ciliaris (L.) R. Br.
Frequent, creek bottom woods, usually sand.

Habenaria clavellata (Michx.) Spreng.
Frequent, creek bottom woods, clay or sand.

Habenaria cristata (Michx.) R. Br.
Frequent, creek bottoms, sandy land.

Habenaria flava (L.) A. Gray.
Lee county, Underwood & Earle (Mohr's Plant Life.)

Habenaria lacera (Michx.) R. Br.
A single collection, Auburn.

†Habenaria quinquiseta (Michx.) Mohr.
(=H. Michauxii Nutt.)
A single collection, Auburn.

Hexalectris aphyllus (Nutt.) Raf.
Occasional, wooded hillsides, Lee county, Clay county, Elmore county.

Leptorchis lilifolia (L.) O. Kuntze.
Rare, creek bottom swamps.

Leptorchis Loeselii (L.) MacM.
Rare, creek bottom swamps, clay.

Limodorum tuberosum L.
Occasional, swamps, sphagnum bogs, etc., sand.

*Listera australis Lindl.
A single speciment, sandy swamp, south of Auburn.

Pogonia ophioglossoides (L.) Ker.
Frequent, sphagnum bogs, etc.

Tipularia unifolia (Muhl.) B. S. P.
Occasional, moist woods, Lee county, Elmore county.

SAURURACEAE.

Saururus cernuus L.
Frequent, swamps.

JUGLANDACEAE.

Hicoria alba (L.) Britt.
Occasicnal, uplands.

Hicoria glabra (Mill.) Britt.
Common, dry upland woods, clay or sand.

Juglans nigra L.
Occasional, rich woods, usually clay.

MYRICACEAE.

‡Myrica cerifera L.
Occasional, sandy swamps.

SALICEAE.

Populus deltoides Marsh.
Occasional, creek and river bottoms.

Salix nigra Marsh.
Common, alder swamps, etc.

BETULACEAE.

rugosa (Du Roi) Koch.
ery common in wet, swampy creek bottoms, the characteristic growth in such locations.

lenta L.
lay county (Mohr's Plant Life).

nigra L.
requent along streams, clay land.

nus Caroliniana Walt.
requent, creek bottoms.

Virginiana (Mill.) Willd.
requent, creek bottoms.

FAGACEAE.

nea dentata (Marsh.) Borkh.
are near Auburn, frequent further north, Chambers county, Tallapoosa county, etc.

nea pumila (L.) Mill.
requent, dry thickets.

us rostrata Ait.
lay county, Tallapoosa county, Randolph county (Mohr's Plant Life). It does not occur near Auburn.

Americana Sweet.
ommon, moist woods, usually creek bottoms.

us acuminata (Michx.) Sargent.
n high hills, Clay county; not seen about Auburn.

us alba L.
requent, rich upland woods, clay land.

cus brevifolia (Lam.) Sargent.
ccasional, dry white sands south of Auburn.

cus coccinea Wang.
ccasional, clay uplands, more abundant northward.

us digitata (Marsh.) Sudw.
ery common, uplands, sand or clay.

cus Margaretta Ashe.
ommon, white sandy soils south of Auburn, but strictly confined to such locations. Very distinct from *Q. minor*, with which it has been confused.

Quercus Marylandica Muench.
(=Q. nigra of authors.) (Black jack.)
Very common, dry, sandy uplands, also on clay.

Quercus minor (Marsh.) Sargent.
Very common, dry uplands, sand or clay.

Quercus Phellos L.
Common, creek bottoms.

*Quercus prinoides Willd.
Occasional, creek bottoms.

†Quercus rubra L.
Occasional, moist clay uplands.

Quercus Schneckii Britton.
Common, uplands, clay or sand.
(=D. Texana Sargent, not Buckl.)

Quercus velutina Lam.
Occasional, clay uplands, frequent in upper counties.

Ulmaceae.

*Celtis Georgiana Small.
Common, dry woods, fence rows, etc., a shrub.

Celtis occidentalis L.
Clay county (Mohr's Plant Life).

Ulmus alata Michx.
Common, dry uplands.

Ulmus Americana L.
Occasional, moist woods, creek bottoms.

Moraceae.

Morus rubra L.
Occasional, rich woods, thickets.

Urticaceae.

Adicea pumila (L.) Raf.
Occasional, swamps.

Boehmeria cylindrica (L.) Willd.
Occasional, swamps.

Urticastrum divaricatum (L.) O. Kuntze.
A single collection, Clay county.

Loranthaceae.

horodendron flavescens (Pursh) Nutt.
Frequent, usually on oaks.

Santalaceae.

estronia umbellulata Raf.
(=Darbya umbellulata. A. Gray.)

A single station, creek bank, 3 miles northwest of Auburn.

Aristolochiaceae.

ristolochia Nashii Kearney.
Occasional, moist, rocky banks.

ristolochia Serpentaria L.
Occasional, moist rocky banks.

Hexastylis arifolium (Michx.) Small.
(=Asarum arifolium Michx.)
Common; rich upland woods.

Hexastylis Ruthii (Ashe) Small.
Occasional, rich woods. (Specimen in Herb. N. Y. Bot. Gard.)

Hexastylis Shuttleworthii (J. Britt.) Small.
Frequent, borders of sphagnum swamps.

Polygonaceae.

runnichia cirrhosa Banks.
A single collection, Tallapoosa county, river bank

olygonum Convolvulus L.
Single collection, Opelika, on the railroad.

Polygonum Hydropiper L.
Occasional, wet places, Lee county, Clay county.

olygonum Opelousanum Riddell.
Common, moist fields, ditch banks, etc.

olygonum Pennsylvanicum L.
Common, moist cultivated fields, etc.

olygonum punctatum Ell.
Common, swamps and wet fields, often growing in standing water.

Polygonum sagittatum L.
Frequent, moist places, ditch banks.

Polygonum setaceum Baldw.
Common, swamps.

Polygonum Virginianum L.
Occasional, swampy woods.

Rumex Acetocella L.
Infrequent, pastures and waste places.

Rumex crispus L.
Common, roadsides and waste places.

‡Rumex hastatulus Muhl.
Very common, fields and waste places. A characteristic grow in abandoned fields.

Rumex obtusifolius L.
Occasional, fields and waste places.

‡Rumex pulcher L.
Streets of Auburn.

CHENOPODIACEAE.

Chenopodium album L.
Frequent, a weed in gardens and rich fields.

Chenopodium anthelminticum L.
Occasional, a weed in waste places.

AMARANTHACEAE.

Amaranthus hybridus paniculatus (L.) U. & B.
Common, a weed in gardens and rich fields.

Amaranthus spinosus L.
Frequent, a weed in gardens and rich fields.

PHYTOLACCACEAE.

Phytolacca decandra L.
Common, rich fence rows and waste places.

NYCTAGINACEAE.

‡Boerhaavia erecta L.
Frequent, a weed in gardens and waste places.

AIZOACEAE.

go verticellata L.
ommon, a weed in gardens and fields.

PORTULACACEAE.

tonia Virginica L.
ne locality, wet, swampy woods 6 miles south of Auburn.

lacca oleracea L.
ccasional, a weed in rich gardens, not found in poor fields.

ım teretifolium Pursh.
ocally common, dry granite outcrops.

CARYOPHYLLACEAE.

e media L.
ommon, a winter weed in gardens and waste places.

ne pubera (Michx.) Britton.
ich wood, river hills Tallapoosa county.

ia dichotoma Michx.
lay county (Mohr's Plant Life).

aria brevifolia Nutt.
ocally common, granite outcrops.

stium brachypodum (Engelm.) Robinson.
ccasional, fields.

stium longipedunculatum Muhl.
ccasional, fields.

tium viscosum L.
ommon, gardens, fields and waste places.

tium vulgatum L.
ommon, gardens, fields and waste places.

a decumbens (Ell.) T. & G.
ommon, fields and gardens.

aria officinalis L.
ccasional, roadsides, introduced.

e antirrhina L.
ccasional, fields and waste places.

e stellata (L.) Ait.
ccasional, rich woods, rocky banks of streams.

Silene Virginica L.
Frequent, rich upland woods, clay.

†Spergula arvensis L.
A single collection, Auburn (1894).

NYMPHAEACEAE.

Brasenia purpurea (Michx.) Casp.
In pond south of Auburn (Vaughn's Mill).

Nymphaea advena Soland.
Frequent, ponds and slow streams.

MAGNOLIACEAE.

‡Illicium Floridanum Ell.
Occasional, banks of streams, Lee county, south of Auburn.

Liriodendron Tulipifera L.
Frequent, moist hillsides and creek bottoms.

Magnolia macrophylla Michx.
Frequent, river hills, Tallapoosa county, Clay county.

Magnolia Virginiana L.
Common, sandy swamps.

ANONAECAE.

Asimina parviflora (Michx.) Dunal.
Frequent, dry or moist places.

Asimina triloba (L.) Dunal.
Banks of Tallapoosa river, Elmore county.

RANUNCULACEAE.

Actaea alba (L.) Mill.
Lee county, Baker & Earle (Mohr's Plant Life).

†Anemone Caroliniana Walt.
Rare, rocky hillsides (Wright's Mill.)

Anemone quinquefolia L.
Frequent, moist wooded hillsides.

Anemone Virginiana L.
A single collection, Chambers county.

‡Clematis crispa L.

Occasional, sandy swamps.

*Clematis glaucophylla Small.

Occasional, dry banks, Tallapoosa county, Elmore county. The leaves are less glancus than in the type and the achenes are narrower.

†Clematis reticulata Walt.

Rocky banks, Tallapoosa river, Elmore county.

Clematis Virginiana L.

Frequent, swamps, clay land.

Delphinium Carolinianum Walt.

Occasional, dry wooded hillsides.

†Hepatica Hepatica (L.) Karst.

Occasional, rich wooded hillsides.

Ranunculus abortivus L.

Frequent, fields and waste places.

Ranunculus hispidus Michx.

Frequent, moist or dry woods.

‡Ranunculus parviflorus L.

Occasional, wet, swampy places.

Ranunculus pusillus Poir.

Occasional, wet, swampy places.

Ranunculus pusillus Lindheimeri A. Gray.

Frequent, wet swampy places.

Ranunculus recurvatus Poir.

Occasional, creek bottom woods.

Ranunculus tener Mohr.

Lee county, Baker & Earle (Mohr's Plant Life).

†Syndesmon thalictroides (L.) Hoffmg.

Frequent, moist wooded hillsides.

Thalictrum clavatum D. C.

Clay county (Mohr's Plant Life).

Thalictrum purpurascens L.

Swampy places, Chambers county, Tallapoosa county.

†Trautvetteria Carolinensis (Walt.) Vail.

A single collection, shaded spring branch, river hills, Elmore county.

Xanthorrhiza apiifolia L. Her.

Frequent, along streams, often on rocky banks.

BERBERIDACEAE.

†Caulophyllum thalictroides (L.) Michx.
One locality, 3 miles northwest of Auburn. Moist, wooded hillside.

Podophyllum peltatum L.
Occasional, creek bottoms.

MENISPERMACEAE.

Calycocarpum Lyoni (Pursh) Nutt.
Rare, creek bottoms.

Cebatha Carolina (L.) Britt.
Frequent, thickets, becoming a troublesome weed in cultivated fields.

CALYCANTHACEAE.

‡Butneria florida (L.) Kearney.
Frequent, moist, rich woods (Mohr's Plant Life credits *Butneria fertilis* to Lee county, but this seems to be an error.)

LAURACEAE.

‡Persea pubescens (Pursh) Sargent.
Frequent, swamps, usually sand .

Sassafras Sassafras (L.) Karst.
Occasional, mixed woods and cultivated fields.

PAPAVERACEAE.

Sanguinaria Canadensis L.
Occasional, rich woods.

CRUCIFERAE.

†Arabis Canadensis L.
Occasional, rocky creek banks, granite outcrops.

Arabis Virginica (L.) Trelease.
Very common, a winter weed in cultivated fields.

*Brassica juncea (L.) Cosson.
Streets of Auburn, introduced.

a Bursa-pastoris (L.) Britt.
Common, fields and waste places.

lamine bulbosa (Schreb.) B. S. P.
Occasional, swampy woods, Lee county, Tallapoosa county.

rdamine Pennsylvanica Muhl.
Occasional, rocky hillsides, granite outcrops.

nopus didymus (L.) J. E. Smith.
Common, upland fields and gardens.

a brachycarpa Nutt.
Common, upland fields, granite outcrops.

ba verna L.
Common, upland fields (*Draba Carolinia* is credited to Lee county in Mohr's Plant Life. This is an error, as the species is clearly *D. verna*.)

dium Virginicum L.
Common, a weed in fields and gardens.

CAPPARIDACEAE.

nisia trachysperma T. & G.
Tallapoosa county (Mohr's Plant Life).

DROSERACEAE.

sera brevifolia Pursh.
Frequent, borders of sphagnum bogs.

PODOSTEMACEAE.

stemon ceratophyllum Michx.
Lee county, Baker & Earle (Mohr's Plant Life).

CRASSULACEAE.

morpha pusilla (Michx.) Nutt.
Locally abundant, granite outcrops.

PENTHORACEAE.

horum sedoides L.
Occasional, swamps.

SAIXFRAGACEAE.

†Heuchera Americana L.
Frequent, dry rocky hillsides, granite outcrops.

Heuchera hispida Pursh.
Metamorphic hills, Talledega county (Mohr's Plant Life).

Parnassia asarifolia Vent.
Clay county (Mohr's Plant Life.)

Philadelphus grandiflorus Willd.
Lee county Underwood & Earle (Mohr's Plant Life). Very rare, seen only once.

†Saxifraga Virginiensis Michx.
Rare, in rock crevices, a single locality two miles northwest of Auburn.

Tiarella cordifolia L.
Occasional, moist, rocky woods, near springs.

HYDRANGEACEAE.

Decumaria barbata L.
Frequent, a high climbing vine in moist woods.

Hydrangea arborescens L.
Occasional, moist woods and rocky banks.

Hydrangea arborescens cordata (Pursh) T. & G.
Clay county (Mohr's Plant Life).

Hydrangea quercifolia Bartr.
Frequent, moist or dry woods.

ITEACEAE.

Itea Virginica L.
Frequent, sandy swamps.

HAMAMELIDACEAE.

Hamamelis Virginiana L.
Frequent, moist woods.

Liquidambar Stryaciflua L.
Common, a tree in mixed woods, both swamps and uplands, also in old fields and second growth timber.

Platanaceae.

Platanus occidentalis L.
Occasional, a large tree in creek bottoms.

Rosaceae.

†Agrimonia mollis (T. & G.) Britt.
Common, moist woods.

Agrimonia parviflora Soland.
Moist woods, Clay county. Not seen at Auburn.

‡Agrimonia pumila Muhl.
Frequent, sandy creek bottoms.

‡Agrimonia striata Michx.
Occasional, moist woods, Lee county, Clay county, Coosa county.

†Amelanchier Botryapium (L.) D C.
Occasional, creek banks and borders of swamps.

*Amygdalus Persica L.
Freely escaped, roadsides, old fields and second growth woods. (Peach.)

Aronia arbutifolia (L. f.) Ell.
Common, swamps.

†Aruncus Aruncus (L.) Karst.
Rare, moist woods, Auburn.

‡Cotoneaster Pyracantha (L.) Spach.
Sparingly escaped, roadsides, Auburn.

Crataegus apiifolia (Marsh.) Michx.
Occasional, creek bottoms.

Crataegus collina Chapm.
Common, dry woods, usually sand.

Crataegus punctata Jacq.
Lee county, Baker & Earle (Mohr's Plant Life).

*Crataegus rubescens Ashe.
Frequent, dry woods, Auburn—the type locality.

Crataegus spathulata Michx.
Common, upland woods and granite outcrops.

Crataegus uniflora Moench.
Frequent, dry woods, sand or clay.

‡Duchesnea Indica (Andr.) Focke.
Common, creek bottoms.

Fragaria Virginiana L.
Common, dry open woods, usually on clay.

†Geum Canadense Jacq.
A single collection, Clay county.

Malus augustifolia (Ait.) Michx.
Frequent, along streams.

Opulaster opulifolius (L.) O. Kuntze.
Locally abundant, creek bottoms, Wright's Mill.

Porteranthus stipulatus (L.) Britt.
A single collection, Tallapoosa county.

Potentilla Canadensis L.
Frequent, dry banks and open woods.

*Potentilla humilis Poir.
A single collection, river hills, Tallapoosa county.

Prunus Americana Marsh.
Clay county (Mohr's Plant Life).

Prunus augustifolia Marsh.
Very common, old fields, roadsides (Old field plum.)

Prunus Caroliniana (Mill.) Ait.
Planted as an ornamental tree and sparingly escaped ("mock orange.")

Prunus gracilis Engelm.
Lee county, Baker & Earle (Mohr's Plant Life).

‡Prunus hortulana Bailey.
Frequent, rich clay woods, upland or creek bottoms. A large tree with loose, shelling bark.

Prunus injucunda Small.
Common, dry land, sand or clay. A small tree with close dark bark. (Southern sloe.)

Prunus serotina Ehrh.
Frequent, rich woods, clay or sand.

Prunus serotina neo-montana Sudw.
Clay county (Mohr's Plant Life).

Rosa humilis Marsh.
Common, dry woods and roadsides.

‡Rosa laevigata Michx.
Occasional, roadsides, introduced.

rubiginosa L.
Roadsides, Chambers county, introduced.

is argutus Link.
Very common, creek bottoms, also uplands. Exceedingly variable, the common high bush blackberry.

is argutus floridus (Tratt.) Bailey.
Occasional, dry uplands.

is cuneifolius Pursh.
Very common, sandy uplands, the "old field" blackberry.

is Enslenii Tratt.
Frequent, pine and mixed woods in shade.

is invisus Bailey.
Frequent, rich woods and open places (dewberry).

is trivialis Michx.
Common, roadsides and fields, evergreen dewberry. (Mohr's Plant Life credits *Rubus hispidus* to Lee county. This is certainly a mistake. The specimens so determined being forms of *R. trivialis*.)

MIMOSACEAE.

izzia Julibrissin Durazz.
Abundantly escaped, roadsides and woods. A good sized tree.

ongia augustata (T. & G.) Britt.
Common, dry sandy woods.

CESALPINACEAE.

ia Marylandica L.
Occasional, fields and roadsides, Clay county.

ia occidentalis L.
Very common, a weed in cultivated fields.

ia Tora L.
Very common, a weed in cultivated fields.

is Canadensis L.
Occasional, rich woods.

aaecrista multipinnata (Pollard) Greene.
Common, moist or dryish woods and thickets.

maecrista nictitans (L.) Moench?
A single doubtful specimen, Clay county.

Chamaecrista robusta Pollard.
Common, moist woods and thickets, creek bottoms.

Gleditsia triacanthos L.
Occasional, rich woods.

PAPILIONACEAE.

Amorpha fruticosa L.
Banks of Tallapoosa, Elmore county.

Amorpha virgata Small.
Clay county (Mohr's Plant Life).

Apios Apios (L.) MacM.
Occasional, rich woods and thickets, usually clay.

Baptisia megacarpa Chapm.
Tallapoosa county (Mohr's Plant Life).

‡Bradburya Virginiana (L.) O. Kuntze.
Frequent, thickets, etc. usually sand.

Chrysaspis dubia (Sibth.) Greene.
Occasional, roadsides and waste places.

†Chrysaspis procumbens (L.) Desv.
Occasional, roadsides and waste places.

Clitoria Mariana L.
Common, dry woods.

Cracca spicata (Walt.) O. Kuntze.
Common, dry woods.

Cracca Virginiana L.
Common, dry woods.

‡Crotalaria Purshii D. C.
A single collection, dry pine woods, Auburn.

Crotalaria rotundifolia (Walt.) Poir.
Frequent, dry woods and open places.

Crotalaria sagittalis L.
Occasional, dry woods and open places.

Dolicholus erectus (Walt.) Vail.
Frequent, dry pine or mixed woods.

†Dolicholus simplicifolius (Walt.) Vail.
Frequent, sandy pine woods.

†Dolicholus tormentosus (L.) Vail.
Occasional, sandy pine woods.

Falcata Pitcheri (T. & G.) O. Kuntze.
Cleburne county (Mohr's Plant Life.)

Galactea volubilis (L.) Britt.
Common, dry woods and thickets.

Lespedeza capitata Michx.
Occasional, sanay open woods.

Lespedeza frutescens (L.) Britt.
Common, dry open woods.

Lespedeza hirta (L.) Ell.
Common, dry open woods.

Lespedeza Nuttallii Darl.
A single collection, Auburn.

Lespedeza procumbens Michx.
Common, dry open woods.

Lespedeza repens (L.) Bart.
Common, dry open woods.

Lespedeza striata (Thunb.) H. & A.
Common, old fields, roadsides and waste places (Japan clover).

Lespedeza Stuvei Nutt.
Common, dry open woods.

Lespedeza Virginica (L.) Britt.
Common, dry open woods.

Medicago Arabica All.
Sparingly introduced, fields and roadsides (Bur clover.)

Meibomia arenicola Vail.
Frequent, dry sandy or rocky woods.

Meibomia Dillenii (Darl.) O. Kuntze.
Common, fields and open woods.

Meibomia grandiflora (Walt.) O. Kuntze.
Rich woods, Coosa county. Not seen at Auburn.

Meibomia laevigata (Nutt.) O. Kuntze.
Common, rich shady woods.

Meibomia Marylandica (L.) O. Kuntze.
Occasional, moist woods.

Meibomia Michauxii Vail.
Frequent, dry woods, usually on rocky hillsides.

Meibomia nudiflora (L.) O. Kuntze.
Occasional, moist rich woods, usually clay.

Meibomia obtusa (Muhl.) Vail.
Frequent, dry sandy woods.

Meibomia paniculata (L.) O. Kuntze.
Common, moist to dry woods.

*Meibomia paniculata Chapmani Britt.
Frequent, moist to dry woods.

*Meibomia paniculata pubens (T. & G.) Vail.
Occasional, dry woods.

†Meibomia rhombifolia (Ell.) Vail.
Frequent, dry woods.

Meibomia rigida (Ell.) O. Kuntze.
Occasional, dry woods.

‡Meibomia stricta (Pursh) O. Kuntze.
Occasional, sandy woods and roadsides.

‡Meibomia viridiflora (L.) O. Kuntze.
Occasional, pine or mixed woods.

Melilotus alba Desv.
Sparingly introduced, roadsides.

Phaseolus polystachyus (L.) B. S. P.
Occasional, rich woods.

Psoralea pedunculata (Mill.) Vail.
Common, pine or mixed woods.

Robinia hispida L.
Clay county (Mohr's Plant Life).

Robinia Pseudacacia L. ?
Rare, a shrub in dry woods (Wright's Mill).

‡Sesban macrocarpa Muhl.
Introduced, an occasional weed in sandy fields.

Strophostyles umbellata (Muhl.) Britton.
Frequent, dry open places.

Stylosanthes biflora (L.) B. S. P.
Frequent, dry woods and open places.

Stylosanthes riparia Kearney.
Frequent, woods and banks.

‡Trifolium Carolinianum Michx.
Common, roadsides and grassy places.

Trifolium pratense L.
Sparingly introduced, streets of Auburn.

'rifolium reflexum L.
Occasional, dry woods, often in rocky places.

'rifolium repens L.
Sparinginly introduced, streets and roadsides.

'icia Hugeri Small.
Frequent, rich mixed woods. (*V. micrantha* Nutt in credited to Lee county, Mohr's Plant Life. This is an error, the plant being a narrow leaved form of V. *Hugeri*.)

'icia sativa L.
Introduced, streets of Auburn.

GERANIACEAE.

ieranium Caroliniaum L.
Common, fields and waste places.

ieranium maculatum L.
Occasional, swampy woods.

OXALIDACEAE.

)xalis recurva Ell.
Very common, dry pine and mixed woods, (*Oxalis cymosa* and *O. grandis* are both credited to Lee county, Mohr's Plant Life. Probably in each case this is an error.)

)xalis stricta L.
Very common, fields and waste places.

)xalis violacea L.
Common, dry open woods and rocky hillsides.

LINACEAE.

inum Floridanum (Planch.) Trelease.
Occasional, open sandy places.

inum striatum Walt.
Occasional, moist woods, usually clay.

RUTACEAE.

Ptelea trifoliata L.
Occasional, river banks, Tallapoosa county, Clay county.

Simaroubaceae.

Ailanthus glandulosa Desf.
Occasional, roadsides, etc., introduced.

Meliaceae.

‡Melia Azederach L.
Abundant, roadsides, fence rows and old fields, introduced.

Polygalaceae.

Polygala ambigua Nutt.
Frequent, dry woods, Clay county, Tallapoosa county.

Polygala Boykini Nutt.
A single collection, Clay county. (Not Lee county, as state in Mohr's Plant Life.)

Polygala cruciata L.
Occasional, sandy swamps.

Polygala Curtissii A. Gray.
Occasional, pine woods, Lee county, Clay county.

‡Polygala grandiflora Walt.
Frequent, dry pine and mixed woods.

Polygala incarnata L.
Occasional, dry pine and mixed woods.

Polygala Mariana Mill.
A single collection, Auburn.

‡Polygala nana (Michx.) D C.
Occasional, sandy land south of Auburn.

Polygala Nuttallii T. & G.
A single collection, Auburn.

Polygala polygama Walt.
Frequent, rich woods, usually clay.

Polygala verticillata L.
A single collection, Auburn. (S. M. Tracy.)

Euphorbiaceae.

Acalypha gracilens A. Gray.
Common, dry woods.

‡Acalypha ostryaefolia Riddell.
Occasional, fields and gardens.

Acalypha Virginica L.
One collection, Clay county,' one Lee county.

Croton glandulosus septentrionalis Muell. Arg.
Occasional, roadsides and waste places.

Croton Texensis (Klotsch.) Muell. Agr.
Tallapoosa county (Mohr's Plant Life.)

Crotonopsis linearis Michx.
Frequent, dry roadsides and granite outcrops.

*Euphorbia apocynifolia Small.
Common, moist woods.

Euphorbia corollata L.
Common, dry woods.

*Euphorbia corollata paniculata Ell.
Common, dry woods.

Euphorbia maculata L.
Common, dry fields and waste places.

*Euphorbia olivacea Small.
Occasional, dry woods.

Euphorbia Preslii Guss.
Common, cultivated fields.

‡Jatropha stimulosa Michx.
Frequent, dry open woods, usually sand.

‡Stillingia ligustrina Michx.
Banks of Tallapoosa river, Tallapoosa county.

‡Stillingia sylvatica L.
Common, dry sandy land.

Tragia nepetaefolia Cav.
Frequent, rocky turned out fields.

‡Tragia urens L.
Occasional, dry open places.

CALLITRICACEAE.

Callitriche Austini Engelm.
Frequent, bare ground in old fields.

Callitriche heterophylla Pursh.
Frequent, floating in running water.

ANACARDIACEAE.

Rhus aromatica Ait.
Clay county (Mohr's Plant Life).

Rhus copallina L.
Common and variable, poor to rich soil, clay or sand.

Rhus glabra L.
Frequent, rich woods and thickets.

Rhus radicans L.
Common, a high climbing vine, (poison ivy, poison oak).

Rhus Toxicodendron L.
Frequent, dry rocky or sandy hills, a low shrub.

Rhus vernix L.
Frequent, sandy swamps, (Thunderwood).

CYRILLACEAE.

‡Cyrilla racemiflora L.
Frequent, creek bottom swamps, sand or clay.

AQUIFOLIACEAE.

*Ilex Beadlei Ashe.
Occasional, dry sand hills, south of Auburn.

Ilex decidua Walt.
Occasional, moist thickets.

‡Ilex glabra (L.) A. Gray. 1.
Frequent, sandy swamps.

‡Ilex glabra (L.) A. Gray. 2.
Occasional, banks of streams, clay land.

Ilex opaca Ait.
Common, moist to dry woods, usually sand.

Ilex monticola mollis (A. Gray) Britt.
A single collection, south of Auburn, sandy swamp.

CELASTRACEAE.

Euonymus Americanus L.
Frequent, moist thickets.

1. Mohr's Plant Life, 604, credits *Ilex coreacea* (Pursh) Chap to Lee county . This seems to be an error. The specimens cited prove to be a broad leaved form of *I. glabra.*

ACERACEAE.

cer Floridanum (Chapm.) Pax.
Occasional, moist creek banks (Wright's Mill).

er leucoderme Small.
Frequent, moist rocky banks, etc., not in swamps.

cer Negundo L.
Local, Wright's Mill. Lee county.

er rubrum L.
Common, swamps.

er saccharum barbatum (Michx.) Trelease.
Clay county (Mohr's Plant Life).

HIPPOCASTANACEAE.

sculus parviflora Walt.
Occasional, northern edge of Lee county and northward, clay.

sculus Pavia L.
Common. dry woods.

BALSAMMACEAE.

patiens biflora Walt.
Frequent, swamps. clay land.

SAPPINDACEAE.

rdiospermum halicacabum L.
Clay county (Mohr's Plant Life).

RHAMNACEAE.

erchemia scandens (Hill) Trelease.
Frequent, moist thickets.

anothus Americanus L.
Common, dry woods.

amnus Caroliniana Walt.
Clay county (Mohr's Plant Life).

mpelopsis arborea (L.) Rusby.
Occasional, south of Aubcrn (Wright's Mill).

rthenocissus quinquefolia (L.) Planch.
Frequent, moist woods and thickets.

Vitis aestivalis Michx.
Frequent, dry or moist woods.

Vitis bicolor LeConte.
Clay county (Mohr's Plant Life).

Vitis cordifolia Michx.
Frequent, uplands, usually clay.

Vitis rotundifolia Michx.
Common, moist woods, creek bottoms, etc.

TILIACEAE.

Tilia heterophylla Vent.
Occasional, creek banks.

MALVACEAE.

Malvastrum angustum A. Gray.
Tallapoosa county (Mohr's Plant Life).

‡Modiola Caroliniana (L.) Don.
Frequent, roadsides and waste places.

‡Sida Elliottii T. & G.
Frequent roadsides, Tallassee; also Lee county, sandy la land.

Sida spinosa L.
Common, gardens and cultivated fields.

HYPERICACEAE.

‡Ascyrum hypericoides L.
Occasional, dry woods.

Ascyrum multicaule Michx.
Frequent, dry woods.

Ascyrum stans Michx.
Occasional, dry woods.

Hypericum Drummondii (Grev. & Hook.) T. & G.
Common, dry open places, roadsides, old fields, etc.

Hypericum maculatum Walt.
Frequent, rich woods.

Hypericum mutilum L.
Common, ditch banks, open moist places.

n nudiflorum Michx.
e collection, Auburn.

n virgatum Lam.
nal, creek banks, Lee county, Clay county.

entianoides L.
n, dry open places, roadsides, old fields, etc.

n petiolatum (Walt.) Britt.
e collection, Tallapoosa county.

n Virginicum (L.) Raf.
e collection, sandy land south of Auburn.

CISTACEAE.

mum Carolinianum Michx.
nal, dry open places, sandy land.

gettii Britt. & Hollick.
it, sandy lands.

emulosa Michx.
nal, dry open places.

osa Ell.
n, dry open places, roadsides, old fields etc.,

VIOLACEAE.

oncolor (Forst.) Raf.
oods, Clay county.

oliniana Greene.
n, sandy woods and open grassy places.

ullata Ait.
e collection, river hills, Tallapoosa county.

icaulis (T. & G.) Britt.
nal, moist upland woods, clay.

ata dilatata Ell.
it, rich upland woods.

lionacea Pursh.
n, creek bottoms and moist ditch banks.

ta L.
n, dry upland woods, clay or sand.

ta bicolor Pursh.
nal, with the last.

‡Viola primulaefolia australis Pollard.
Locally common, open marshy places, Lee county, Tallapoos county.

Viola Rafinesquii Greene.
Very common, fields and waste places.

Viola striata Ait.
Clay county (Mohr's Plant Life).

‡Viola vicinalis Greene.
Frequent, open sandy woods, not found on clay.

Viola villosa Walt.
Rare, dry pine woods, Auburn.

Passifloraceae.

Passiflora incarnata L.
Common, a troublesome weed in fields, especially clay. white flowered form is occasionally seen.

Passiflora lutea L.
Occasional, dry thickets.

Cactaceae.

Opuntia humifusa Raf.
Frequent, roadsides and sandy land.

Lythraceae.

‡Lagerstroemia Indica L.
Frequent, roadsides escaped, (Crape myrtle.)

Rotala ramosior (L.) Koehne.
A single collection, Clay county.

Melastomaceae.

‡Rhexia ciliosa Michx.
A single collection, south of Auburn.

Rhexia lanceolata Walt.
Occasional, wet sandy places.

Rhexia Mariana L.
Frequent, wet sandy places.

‡Rhexia stricta Pursh.
A single collection, Auburn. (P. H. Mell.)

ginica L.
t, wet sandy places, also on clay

ONAGRACEAE.

coloratum Muhl.
e county (Mohr's Plant Life).

hauxii Spach.
t, dry woods and roadsides.

ia speciosa (Nutt.) Small.
ı, roadsides escaped.

lustris L.
ıal, ditches and running streams.

currens (Walt.) D. C.
t, ditches and wet open places.

ptocarpa Nutt.
t, ditches and wet open places.

nearis (Michx.) Spach.
e collection, Chilton county.

nifolia (Nutt.) Spach.
e collection, Lee county.

ongipedicellata Small.
ı, dry open mixed woods, also in second growth woods,
r sand.

ubglobosa Small.
t, moist open sandy places.

lternifolia L.
ı, wet places, clay or sand.

hirtella Raf.
margins of ponds, sandy land.

linearis Walt.
t, wet places, sandy land.

laciniata Hill.
ı, fields and roadsides, a winter weed.

laciniata grandis Britt.
collection, fields near Auburn.

nnis (L.) Scop.
ı, fields and roadsides.

HALORAGIDACEAE.

Myriophyllum sp.
Immature plants from a stream south of Auburn.

Proserpinaca pectinata Lam.
A single collection, roadside ditches, sandy land.

ARALIACEAE.

Aralia spinosa L.
Frequent, rich woods and thickets.

UMBELLIFERAE.

Angelica villosa (Walt.) B. S. P.
Frequent, dry pine and mixed woods, clay or sand.

Chaerophyllum Tainturieri Hook.
Common, a street and roadside weed, also in sandy swamps.

Centella Asiatica (L.) Urban.
Lee county (S. M. Tracy.) Specimen in herb. New York Bot. Garden.

*Cicuta maculata L.
Common, swamps, etc.

‡Daucus pusillus Michx.
Frequent, fields, roadsides and waste places

Deringa Canadensis (L.) O. Kuntze.
Rich woods, Clay county, Coosa county.

‡Hydrocotyle verticellata Thurnb.
Frequent, shaded thickets, clay or land.

Eryngium yuccaefolium Michx.
Common, dry woods and fields.

Oxypolis rigidus (L.) Raf .
Frequent, sandy swamps.

†Ligusticum Canadense (L.) Britt.
Frequent, open marshy places.

1. This is included under *E. integrifolum* Walt. in Mohr's Plant Life, 644, but it seems to differ from the pine-barren plant in more diffuse habit and broader leaves.

gidus (L.) Britt.
it, open marshy places.

Nuttallii D. C.
nty. Baker & Earle) (Mohr's Plant Life).

n capillaceum (Michx.) Hollick.
n, sandy swamps.

anadensis L.
n, moist to rather dry woods.

Floridana Bicknell. 1.
it, dry upland woods.

Iarylandica L.
nal, moist woods.

mallii Bicknell.
it, creek bottom woods.

oarbinode (Michx.) Nutt.
nal, moist thickets, etc

rifoliatum aureum (Nutt.) Britt.
nal, creek bottom woods.

a (L.) Koch.
e collection, Clay county.

ta (Walt.) D C.
it, upland woods, sand or clay.

CORNACEAE.

omum Mill.
n, along streams.

icta Lam.
nty Earle & Baker (Mohr's Plant Life).

ida L.
n, upland woods, clay or sand.

ora Walt.
n, swamps.

r's Plant Life, 645, includes this *with S. Canadensis.* wo seem sufficiently distinct. The shape of the leaves he general aspect are so different that they can be dis-ished at a glance.

Nyssa sylvatica Marsh.
Common, upland woods, usually clay.

PYROLACEAE.

†Chimaphila maculata (L.) Pursh.
Occasional, dry pine woods.

MONOTROPACEAE.

Monotropa uniflora L.
Occasional, rich woods.

ERICACEAE

Azalea arborescens Pursh.
Rare, along streams, clay land

Azalea nudiflora L.
Common, rich woods.

Azalea viscosa L.
Common, swamps, variable.

Azalea viscosa glauca (L.) Michx.
Lee county, Earle & Underwood (Mohr's Plant Life).

Bathodedron arboreum (Marsh.) Nutt.
Common, dry woods (Vaccinum Arboreum Marsh.)

Epigaea repens L.
Rare, dry hillsides, Lee county, Tallapoosa county.

Gaylussacia dumosa (Andr.) T. & G.
Common, dry hillsides.

Gaylussacia frondosa (L.) T. & G.
Frequent, dry rocky hillsides.

*Gaylussacia nana (A. Gray) Small.
Frequent, dry rocky hills.

Kalmia latifolia L.
Common, along streams.

†Leucothoë racemosa (L.) A. Gray.
Border of ponds, sandy land.

Oxydendron arboreum (L.) D C.
Frequent, dry or moist woods.

‡Pieris nitida (Bartr.) B. & H.
Frequent, sandy swamps.

nelanocarpum (Mohr) Greene.
dry upland woods.

nelanocarpum candicans (Mohr).
dry upland woods.

tamineum (L.) Greene.
dry woods.

on punctatum, Andr.
ollection, river hills, Tallapoosa county.

moenum Ait.
dry hillsides.

rymbosum L.
open woods.

iottii Chapm.
banks of streams.

uscatum Ait.
phagnum bogs.

yrsinites Lam.
dry rocky hills.

yrsinites glaucum A. Gray.
with the type.

nellum Ait.
moist hillsides.

cillans Kalm.
dry rocky hills.

irgatum Ait.
, banks of streams.

strina (L.) Britt.
moist woods, banks of streams.

PRIMULACEAE.

quadrifolia L.
ollection, Talladega county.

bundus H. B. K.
swamps.

liatum (L.) Raf.
moist woods.

nceolatum (Walt.) A. Gray.
moist woods.

Steironema lanceolatum augustifolum A. Gray.
Lee county. (Earle & Baker) (Mohr's Plant Life).

*Steironema quadriflorum (Sims) A. S. Hitchcock.
A single collection, moist woods, Auburn, clay land.

Steironema tonsum (Wood) Bicknell.
A single collection, Clay county.

EBENACEAE.

Diospyros Virginiana L.
Common, dry woods (=Vaccinum Arboreum Marsh.)

SIMPLOCACEAE.

Symplocos tinctoria (L.) L'Her.
Frequent, moist hillsides and along streams.

STYRACEAE.

Mohrodendron Carolinum (L.) Britt.
Common, along streams.

†Mohrodendron dipterum (Ell.) Britt.
Banks of Tallapoosa river, Elmore county, Tallapoosa count

Styrax Americana Lam.
Common, along streams.

Styrax grandifloria Ait.
Rare, upland woods, clay land.

OLEACEAE.

Chionanthus Virginica L.
Occasional, moist woods and along streams.

Fraxinus lanceolata Borck.
Occasional, creek and river bottoms.

†Osmanthus Americanus (L.) B. & H.
Frequent, along streams and moist hillsides.

LOGANIACEAE.

*Buddleia Japonica Hemsl.
Sparingly escaped, roadsides.

Gelsemium sempervirens (L.) Ait.
Frequent, climbing over trees in moist or dry thickets, sa
or clay (Yellow jasmine.)

procumbens L.
ry field and waste places.

landica L.
ich, shady woods.

GENTIANACEAE.

inica (L.) B. S. P.
gnum swamps.

ponaria L.
along creek banks.

sa L.
dry woods, usually clay.

laris (L.) Pursh.
dry rich woods, usually clay.

inii A. Gray.
voods, Clay county, Coosa county.

MENYANTHACEAE.

um lacunosum (Vent.) Griseb.
h of Auburn.

APOCYNACEAE.

onia (L.) Britt.
reek bottom woods.

nnabinum L.
fields, south of Auburn.

ASCEPIADACEAE.

plexicaulis Michx.
dry sand hills south of Auburn, never in clay.

sifolia Michx.
thin upland woods, clay or sand.

rosa L.
ry woods and roadsides.

egata L.
ry woods and roadsides, sand or clay.

icillata L.
ry woods and roadsides, sand or clay.

Vincetoxicum hirsutum (Michx.) Britt.
Occasional, rich woods, usually clay.

CONVOLVULACEAE.

‡Breweria humistrata (Walt.) A Gray.
Frequent, dry sandy pine woods.

‡Convolvulus repens L.
Frequent, dry woods, sand or clay.

Ipomoea barbigera (Don.) Sweet.
Common, upland fields.

Ipomoea hederacea Jacq.
Lee county, Earle (Mohr's Plant Life).

Ipomoea lacunosa L.
Occasional, creek bottom fields.

Ipomoea pandurata (L.) Meyer.
Frequent, dry woods and roadsides.

Ipomoea purpurea (L.) Roth.
Lee county, Earle (Mohr's Plant Life).

‡Jacquemontia tamnifolia (L.) Griseb.
Common, a weed in fields.

†Quamoclit coccinea (L.) Moench.
Occasional, cultivated fields.

CUSCUTACEAE.

Cuscuta arvensis Beryrich.
Lee county, Earle (Mohr's Plant Life).

Cuscuta sp.
Other species occur, but the specimens have not been de mined.

POLEMONIACEAE.

Phlox amoena Sims.
Frequent, dry pine and mixed woods.

Phlox glaberrima L.
Frequent, dry mixed woods.

Phlox maculata L.
Occasional, upland woods.

ılata L.
collection, Coosa county.

ılata acuminata (Pursh) Chapm.
ty, Baker & Earle (Mohr's Plant Life).

L.
moist mixed woods.

HYDROPHYLLACEAE.

rivalvis (Walt.) O. Kuntze.
f pond south of Auburn.

bia (L.) Small.
bundant, dry granite outcrops.

BORAGINACEAE.

n Indicum L.
l, roadsides and waste places.

ginica (L.) Greene.
l, moist woods, clay land.

scabriuscula Ait.
l, open grassy places.

ı Carolinianum (Lam.) A. D C.
l, dry sandy fields and open woods.

VERBENACEAE.

ımericana L.
dry woods, sand or clay. A form with white fruit

cteosa Michx.
l, roadsides and waste places.

roliniana Michx.
dry sandy woods.

ıs-castus L.
scaped, roadsides, etc.

ture specimens of this plant were determined as
is Virginica and were so reported in Mohr's Plant
91. The true M. Virginica has not so far been found.

LABIATAE.

†Blephila ciliata (L.) Raf.
  Frequent, dry hillsides, clay land.

†Clinopodium Nepeta (L.) O. Kuntze.
  A single collection, Clay county.

Clinopodium Carolinianum (Michx.) Heller.
  Locally common, dry sandy flats, banks of Tallapoosa Tallapoosa county.

Collinsonia anisata Pursh.
  Common, dry pine and mixed woods.

*Collinsonia Canadensis punctata A Gray.
  A single collection, swamp south of Auburn.

Collinsonia scabriuscula Ait.
  Opelika, Lee county (Mohr's Plant Life).

Hedeoma pulegioides (L.) Pers.
  Tallapoosa county, Clay county, not found at Auburn.

‡Koellia albescens (T. & G.) O. Kuntze.
  A single collection, Clay county.

Koellia flexuosa (Walt.) Mac M.
  Occasional, moist open places.

*Koellia incana (L.) O. Kuntze.
  Common, dry open woods.

Koellia pycnanthemoides (Leavenw.) O. Kuntze.
  Common, dry open woods.

Lamium amplexicaule L.
  Common, fields and gardens, a Winter weed.

Lycopus Virginicus L.
  Common, wet swampy thickets.

Mentha piperata L.
  Spring branches, Tallapoosa county.

‡Mesosphaerum rugosum (L.) Pollard.
  Frequent, sandy swamps.

*Monarda mollis L.
  Frequent, Clay county, not seen at Auburn.

Monarda punctata L.
  Frequent, dry thickets.

Nepeta cataria L.
  Clay county (Mohr's Plant Life).

garis L.
moist places.

a Lam.
open sandy places, roadsides, etc.

L.
dry or moist woods.

ifolia L.
dry open woods.

cordifolia Muhl.
l, mixed woods, clay land.

ntegrifolia major Chapm.
moist creek bottoms, usually sandy land.

hyssopifolia L.
collection, Auburn.

aterifolia L.
collection, Auburn.

pilosa Michx.
dry mixed woods.

venosa Kearney.
once, Tallapoosa county.

dichotomum L.
Clay county, not seen at Auburn.

a lineare Nutt.
open sandy woods.

SOLANACEAE.

la L.
barnyards and rich gardens.

gulata L.
l, gardens and fields.

---

l. This is a striking species, the plant covered with hitish hairs. Dr. Rydberg considers it new and will ublish a description. An unnamed fragment of the hing collected by Dr. Chapman is in the Columbia sity herbarium.

rginiana Mill.
dry open woods, clay or sand.

Physalodes Physalodes (L.) Britt.
Occasional, gardens and rich fields.

Solanum Carolinense L.
Common, fields and gardens.

Solanum nigrum L.
Common, rich fields and gardens.

Solanum pseudocapsicum L.
Occasional, roadsides.

SCROPHULARIACEAE.

‡Afzelia cassinoides (Walt.) Gmel.
A single collection Clay county.

Afzelia pectinata (Pursh) O. Kuntze.
Frequent, dry pine or mixed woods.

Buchnera Americana L.
Rare, moist open places.

Chelone glabra L.
Rare, moist thickets.

*Dasystoma bignoniflora Small.
A single collection, Clay county.

Dasystoma flava (L.) Wood.
Frequent, dry woods.

Dasystoma pectinata (Nutt.) Benth.
Lee county, Baker & Earle (Mohr's Plant Life).

Dasystoma laevigata (Raf.) Chapm.
Frequent, dry woods.

†Dasystoma Virginica (L.) Britt.
Frequent, rich woods.

*Gerardia microphylla (A. Gray) Small.
Occasional, sandy pine woods.

Gerardia Plukenetii Ell.
Frequent, dry upland woods, clay or sand.

Gerardia purpurea L.
Occasional, wet swampy places.

Frequent, dry woods.

Gratiola Floridana Nutt.
Locally abundant, swamps. Lee county, Tallapoosa cou

ratiola pilosa Michx.

Frequent, moist open places.

ratiola sphaerocarpa Ell.

Frequent, boggy places.

santhes attenuata (Muhl.) Small.

A single collection, bank of pond south of Auburn.

ysanthes refracta (Ell.) Benth.

Occasional, moist granite outcrops.

aria Canadensis (L.) Dumort.

Common, fields and gardens.

icranthemum emarginatum Ell.

A single collection, border of pond south of Auburn.

imulus ringens. L

Frequent, wet ditch banks, etc., clay land.

nniera acuminata (Walt.) O. Kuntze.

Frequent, wet, swampy woods.

dicularis Canadensis L.

Occasional, moist pine or mixed woods.

nstemon hirsutus (L.) Willd.

Common, dry woods.

rophularia Marylandica L.

Infrequent, the only collection from Coosa county.

rbascum Blattaria L.

Rare about Auburn, becoming common farther north.

rbascum Thapsus L.

Occasional, roadsides and waste places.

eronica arvensis L.

Occasional, fields and waste places.

ronica peregrina L.

Frequent, fields and waste places.

LENTIBULARIACEAE.

tricularia fibrosa Walt.

In mud border of pond south of Auburn ,

tricularia subulata L.

Frepuent, sandy swamps.

OROBRANCHACEAE.

†Conopholis Americana (L.) Walt.
Frequent, moist woods, growing on oak, beech and sweet gum roots.

†Leplamnium Virginianum (L.) Raf.
Frequent, moist woods.

†Thalesia uniflora (L.) Britt.
Rare, mixed woods.

BIGNONIACEAE.

Bignonia crucigera L.
Frequent, along streams.

Campsis radicans (L.) Seem.
(=Tecoma radicans D C.)
Common, thickets, roadsides and fields.

Catalpa Catalpa (L.) Karst.
Occasional, along streams.

ACANTHACEAE.

Dianthera Americana L.
Frequent, in running streams.

Ruellia ciliosa hybrida (Pursh) A. Gray.
Lee county, Baker & Earle (Mohr's Plant Life).

Ruellia ciliosa parviflora (Nees) Britt.
Occasional, roadsides and mixed woods, clay land, also on granite outcrops.

Ruellia strepens L.
Clay county (Mohr's Plant Life).

PLANTAGINACEAE.

Plantago aristata Michx.
Common, roadsides and waste places.

*Plantago elongata Pursh.
Collected once, creek bottom pasture, Auburn.

Plantago heterophylla Nutt.
Common, fields and waste places.

antago lanceolata L.
Occasional, roadsides and grassy places.

antago Rugelii Dce.
Occcasional, moist pastures and roadsides.

antago Virginica L.
Common, fields, pastures and waste places,

RUBIACEAE.

phalanthus occidentalis L.
Common, swamps and moist thickets.

odia teres Walt.
Very common, old fields, roadsides, etc.

odia Virginiana L.
Common, ditch banks and wet fields.

lium aparine L.
Occasional, gardens and moist places.

lium circaezans Michx.
Collected once, Auburn, not typical.

alium Claytoni Michx.
Collected once, shaded spring bog, Auburn.

lium pilosum Ait.
Frequent, pine and mixed woods.

alium pilosum puncticulosum (Michx.) T. & G.
Frequent, dry pine woods.

alium uniflorum Michx.
Collected once, moist, rich woods, Auburn.

alium tinctorium L.
Occasional, moist woods.

alium triflorum Michx.
Occasional, rich woods, Lee county, Clay county.

ustonia calycosa (Shuttly.) Mohr.
Tallapoosa county (Mohr's Plant Life).

ustonia coerulea L.
Common, open pine and mixed woods.

ustonia longifolia Gaertn.
Occasional, moist, rocky banks.

Ioustonia minor (Michx.) Britt.
Common, pastures and open places.

Houstonia purpurea L.
Common, rich woods, usually on clay.

Houstonia tenuifolia Nutt.
Frequent, dry open, diciduous woods clay land.

Mitchella repens L.
Common, moist creek banks and sandy swamps.

‡Oldenlandia uniflora L.
Frequent, borders of sphagnum swamps.

‡Richardia scabra L.
Common, sandy cultivated fields, Lee county, Elmore county.

CAPRIFOLIACEAE.

Lonicera flava Sims.
Clay county (Mohr's Plant Life).

Lonicera Japonica Thunb.
Abundantly escaped roadsides, fields and thickets.

Lonicera sempervirens L.
Frequent, climbing in moist thickets.

Sambucus Canadensis L.
Common, thickets and roadsides.

†Symphoricarpus Symphoricarpus (L.) MacM.
Collected once, Clay county.

Viburnum acerifolium L.
Clay county (Mohr's Plant Life).

Viburnum nudum L.
Common, sandy swamps.

Viburnum rufotomentosum Small.
Occasional, moist or dry open woods.

VALERIANACEAE.

Valerianella radiata (L.) Dufr.
Common, creek bottom fields.

CAMPANULACEAE.

Campanula Americana L.
Collected once, Coosa county.

Campanula divaricata Michx.
Frequent, granite ledges Lee county, Tallapoosa county.

ria biflora (R. & P.) A. Gray.
non sandy pastures and roadsides.

a perfoliata (L.) A. DC.
non, fields and roadsides.

LOBELIACEAE.

moena Michx.
ent, sandy swamps.

ardinalis L.
ent, swampy creek bottoms, often on clay.

nflata L.
bottoms, Clay county, rare at Auburn.

eptostachys A. D C.
county (Mohr's Plant Life).

Nuttallii Roem. & Schult.
county (Mohr's Plant Life).

uberula Michx.
non, open woods, often near streams.

picata Lam.
woods, Elmore county Coosa county Clay, county not
n at Auburn.

yphilitica L.
county (Mohr's Plant Life).

CHICORIACEAE.

n Carolinianum (Walt.) Britt.
non, fields, roadsides and waste places.

n Greenii Porter & Britt.
ounty. (Baker & Earle.) Mohr's Plant Life.)

n Gronovii L.
ent, dry pine and mixed woods.

n Marianum Willd.
ional, dry hillsides.

n Scribneri Small.
poosa county (Mohr's Plant Life).

n venosum L.
non, dry rocky wooded hillsides.

Lactuca Canadensis L.
Common, pine woods and open places.

Lactuca Floridana (L.) Gaertn.
Collected once, Auburn.

Lactuca graminifolia Michx.
Occasional, sandy pine woods.

†Lactuca hirsuta Muhl.
Occasional, pine woods.

Lactuca sagittifolia Ell.
Clay county (Mohr's Plant Life).

‡Lactuca villosa Jueq.
Occasional, roadsides.

†Nabalus altissimus (L.) Hook.
Occasional, moist, rich woods, usually creek bottoms.

Nabalus Serpentaria (Pursh) Hook.
Frequent, moist, dry woods, often uplands.

*Nabulus trifoleatus Cass.
Collected once, Auburn, in a garden.

Serinea oppositifolia (Raf.) O. Kuntze.
Occasional, creek bottom fields.

Sitilias Caroliniana (Walt.) Raf.
Common, fields, roadsides and open places. A white flowered form occurs.

Sonchus asper (L.) All.
Frequent, fields and waste places.

CARDUACEAE.

‡Acanthospermum australe (L.) O. Kuntze.
Frequent, along railroad embankments.

Ambrosia artemisiaefolia L.
Common, fields, etc. (dog weed).

*Antennaria nemoralis Greene.
Frequent, dry rocky hillsides and granite outcrops.

Antennaria plantaginifolia (L.) Richards.
Lee county (Mohr's Plant Life).

Anthemis Cotula L.
Occasional, roadsides and waste places, usually not abundant

aptosorus Small.
on, shaded, rocky hillsides.
olor L.
on, dry sandy roadsides and open woods.
aricatus L.
ed once, Clay county.
osus L.
onal, borders of fields and thickets. ,
oides L.
on, swamps and waste places.
oides platyphyllus T. & G.
unty. (Baker & Earle.) (Mohr's Plant Life.)
oides pilosus (Willd.) Porter.
on, fields, roadsides and waste places.
suticaulis Lindl.
ed once, Auburn.
thinus Burgess.
ed once, Auburn.
is L.
unty Mohr's Plant Life).
riflorus (L.) Britt.
on, alder swamps, wet thickets and borders of fields.
ngiolius Nutt.
unty (Mohr's Plant Life).
ens Ait.
on, roadsides and dry woods, clay land.
iceus L.
on, alder swamps and moist thickets.
rpuratus Nees.
nt, clay roadsides.
ttifolius Willd.
ed once, Auburn.
rtii Hook.
banks, Tallapoosa river, Elmore county.,
descanti L.
nt, moist, shady woods.

‡Aster dumosus cordifolius (Michx.) T. & G.
Very common, dry rocky hillsides. Exceedingly variable. collections probably include several of the named variet

Aster vimineus foliosus (Ait.) A. Gray.
Lee county (Mohr's Plant Life).

Aster undulatus L.
Common, cultivated fields and waste places.

Bidens frondosa L.
Common, fields and swampy places.

†Brauneria purpurea (L.) Britt.
Collected once, clay roadsides, Chambers county.

Carduus altissimus L.
Common, moist thickets, etc.

*Carduus discolor (Muhl.) Nutt.
Occasional, moist thickets and open woods.

Carduus lanceolatus L.
Clay county (Mohr's Plant Life.)

‡Carduus spinosissimus Walt.
Rare, open sandy land.

Carduus spinosissimus Elliotti (T. & G.) Porter.
Common, old fields, roadsides and open woods, mostly on c Worthy of specific rank, often reaches more than three f in height.

Carduus Virginianus L.
Occasional, sandy roadsides.

‡Chrysogonum Virginicum L.
Occasional, deciduous woods, clay land.

Chysopsis graminifolia (Michx.) Nutt.
Very common, pine and mixed woods, especially on sand.

Chrysopsis Mariana (L.) Nutt.
Common, pine and mixed woods.

Cnicus benedictus L.
Collected once, railroad tracks, Auburn.

‡Coleosanthus cordifolius (Ell.) O. Kuntze.
Occasional, sandy woods and roadsides.

Coreopsis auriculata L.
Common, moist pine and mixed woods, clay or sand.

*Coreopsis bicolor.
Collected once, fields south of Auburn, escaped.

opsis delphinifolia Lam.
Collected once, fields, Chambers County.

opsis grandiflora Hogg.
Locally abundant, moist granite outcrops.

opsis lanceolata L.
Frequent, open pine woods, usually sand.

opsis major Walt.
Common, dry pine and mixed woods.

opsis Oemleri Ell.
Frequent, dry pine and mixed woods. It intergrades freely with the last species and can hardly be considered distinct.

opsis pubescens Ell.
Collected once, Tallapoosa County.

opsis tripteris L.
Occasional, ditch banks and margins of creek bottom fields, clay land.

opsis verticillata L.
Lee county, (Mohr's Plant Life).

llingeria humilis (Willd.) Britt.
Occasional, creek bottom woods.

llingeria infirma (Michx.) Greene.
Collected once, Lee County; once, Clay County.

hantopus Carolinianus Willd.
Frequent, creek bottom woods and thickets, clay or sand.

phantopus elatus Bertol.
Collected once, Auburn; once Macon County.

hantopus nudatus A. Gray.
Common, shaded creek bottoms, sandy land.

hantopus tomentosus L.
Common, creek bottoms and dryer locations, in shade or exposed, clay or sand.

htites hieracifolia (L.) Raf.
Frequent, rich newly-cleared fields and waste places.

eron annuus (L.) Pers.
Occasional, moist creek bottom fields and waste places.

eron Philadelphicus L.
Collected once, Auburn; moist woods, clay.

geron pulchellus Michx.
Frequent, rich woods.

†Erigeron ramosus (Walt.) B. S. P.
Common, fields roads.des and waste places.

Erigeron ramosus Beyrichii (F. & M.) Smith & Pou
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Eupatorium ageratoides L.
Occasional, creek bottom swamps.

Eupatorium album L.
Common, dry woods, clay or sand.

Eupatorium amoenum Pursh.
Clay county, (Mohr's Plant Life.)

Eupatorium aromaticum L.
Common, dry pine and mixed woods.

Eupatorium capillifolium (Lam.) Small.
Very common, pastures, old fields, roadsides and waste pla
usually in moist land.

‡Eupatorium coelestinum L.
Occasional, swamps.

Eupatorium compositifolium Walt.
Frequent, dry old fields and open woods.

Eupatorium cuneifolium Willd.
Frequent, dry sandy pine woods.

Eupatorium hyssopifolium L.
Occasional, dry sandy woods.

Eupatorium linearifolium Walt.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Eupatorium perfoliatum L.
Common, swampy places, clay or sand.

*Eupatorium petaloideum Britt.
Collected once, Auburn.

Eupatorium pinnatifidum Ell.
Rare, dry open woods.

Eupatorium pubescens Muhl.
Lee count. (Baker & Earle.) (Mohr's Plant Life.)

Eupatorium purpureum L.
Common, creek bottoms and swamps, especially clay land

Eupatorium rotundifolium L.
Common, creek bottoms, usually sandy land.

atorium semiserratum D C.
Frequent, sandy pine woods.

torium serotinum Michx.
Occasional, moist roadsides and waste places.

torium Smithii Greene & Mohr.
Chambers County. (Mohr, Plant Life.)

atorium Torreyanum Short.
Clay roadsides, Chambers county.

atorium tortifolium Chapm.
Frequent, dry sandy pine woods.

torium verbenaefolium Michx.
Common, swampy woods, sandy land.

lardia lanceolata Michx.
Common, open sandy pine woods, etc.

phalium Hellleri Britt.
Common, open pine and mixed woods.

halium purpureum L.
Common, a winter weed in fields and waste places.

halium obtusifolium L.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

phalium Helleri Britt.
Collected once, banks of Tallapoosa river.

nium autumnale L.
Common, with the last.

enium Nuttallii A. Gray.
Frequent, alder swamps and creek bottoms.

enium tenuifolium Nutt.
Very common, fields, pastures and roadsides; (bitter weed.)

nthus angustifolius L.
Common, open swampy places.

nthus atrorubens L.
Occasional, roadsides and woods, clay land.

nthus divaricatus L.
Frequent, dry woods and roadsides.

nthus hirsutus Raf.
Frequent, dry woods and roadsides.

nthus hirsutus trachyphyllus T. & G.
Clay county. (Mohr's Plant Life.)

Helianthus microcephalus T. & G.
Common, dry woods and roadsides.

Helianthus Sweinitzii T. & G.
Lee County, (Mohr, Plant Life.)

Helianthus tomentosus Michx.
Frequent, rich mixed woods.

Heliopsis gracilis Nutt.
Occasional, moist upland woods.

Heliopsis helianthoides (L.) B. S. P.
Collected once, Tallapoosa County.

Ionactis linariifolia (L.) Greene.
Common, roadsides and open pine woods, sandy land.

Isopappus divaricatus (Nutt.) T. & G.
Very common, old fields, pastures and roadsides.

Kuhnia eupatorioides L.
Common, dry open woods, usually on sandy land.

*Lacinaria Earlei Greene.
Auburn. (F. S. Earle, 1896.)

‡Lacinaria elegans (Walt.) O. Kuntze.
Locally abundant, sandy pine woods, south of Auburn.

*Lacinaria elegantula Greene.
Auburn. (F. S. Earle, 1896.)

†Lacinaria graminifolia (Walt.) O. Kuntze.
Common, dry pine and mixed woods. A form with flowers occurs.

†Lacinaria scariosa squarrulosa (Michx.) Small.
Collected once, Auburn.

‡Lacinaria spicata (L.) O. Kuntze.
Occasional, pine woods.

Lacinaria squarrosa (L.) Hill.
Occasional, dry woods.

Leptilon Canadense (L.) Britt.
Common, cultivated fields.

‡Mariana Mariana (L.) Hill.
Collected once, streets of Auburn.

Marshallia lanceolata Pursh.
Frequent, open pine and mixed woods.

Marshallia trinerva (Walt.) Porter.
Occasional, thickets along small streams.

riplicifolia (L.) Raf.
Tallapoosa river, Tallapoosa county.

vata (Walt.)
moist mixed woods.

enifornis (Muhl.) Raf.
once, Clay county.

integrifolium L.
ty, Tallapoosa county, Lee county, (Mohr, Plant

tida (L.) B. S. P.
, swamps and creek bottoms.

olata Cass.
creek bottoms and swamps.

nadensis L.
ty (Mohr's Plant Life.)

nadensis radiata A. Gray.
lladega mountains, Clay county.

edalia L.
, roadsides and moist open woods.

lgida Ait.
moist upland woods.

rta L.
dry open woods.

ciniata L.
creek bottoms and swamps.

athulata Michx.
ty, Talladega county, Lee county, (Mohr's Plant

iloba L.
once, northern Lee county.

uncata Small.
once, Auburn.

ei Small.
mon, dry open woods and waste places.

tus Pers.
on, creek bottoms.

mingeri Britt.
ty. (Underwood & Earle.) (Mohr's Plant Life.)

Senecio obovatus Muhl.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Senecio Smallii Britt.
Clay county, Tallapoosa county, Lee county, (Mohr's P

Sericocarpus asteroides (L.) B. S. P.
Common, dry pine and mixed woods.

Sericocarpus bifoliatus (Walt.) Porter.
Occasional, dry sandy pine woods.

Sericocarpus linifolius (L.) B. S. P.
Common, dry pine or mixed woods.

Silphium asperimum Hook.
Clay county. (Mohr's Plant Life.)

Silphium asteriscus L.
Common, upland woods, clay or sand.

Silphium compositum Michx.
Common, upland woods, clay or sand.

Silphium dentatum Ell.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Silphium laevigatum Pursh.
Lee county. (Baker & Earle.) (Mohr's Plant Life.)

Silphium trifoliatum L.
Clay county (Mohr's Plant Life.)

†Solidago amplexicaulis T. & G.
Frequent, rocky hillsides, mixed woods.

Solidago arguta Ait.
Clay County. (Mohr, Plant Life.)

Solidago Boottii Hook.
Common, creek bottom woods.

Solidago brachyphylla Chap.
Lee county. (Earle.) (Mohrs' Plant Life.)

†Solidago caesia L.
Common, moist rich woods.

Solidago Canadensis L.
Very common, fields and waste places.

†Solidago erecta Pursh.
Frequent, dry sandy creek bottoms.

‡Solidago fistulosa Mill.
Collected once, Clay county.

go neglecta T. & G.
e county. (Baker & Earle.) (Mohr's Plant Life.)

go nemoralis Ait.
ry common, dry roadsides, old fields and dry open second-growth woods.

go odora Ait.
ry common, dry pine and mixed woods.

go pallescens Mohr.
mmon, dry rocky hillsides, mixed woods.

go patula strictula T. & G.
equent, moist woods, creek bottoms, etc.

go petiolaris Ait.
mmon, sandy pine woods.

go rugosa Mill.
mmon, creek bottoms, alder swamps.

go salicina Ell.
e county (Mohr's Plant Life.)

ago serotina Ait.
mmon, creek bottom fields and moist places.

go ulmifolia Muhl.
mmon, creek bottom woods.

go Vaseyi Heller.
ay county (Mohr's Plant Life.)

gonotheca helianthoides L.
mmon, dry open woods and roadsides, usually sandy land.

ina alternifolia (L.) Britt.
ay county (Mohr's Plant Life.)

ina aristata (Ell.) Heller.
mmon, dry pine and mixed woods.

sina Virginica L.
equent, dry open creek bottom woods.

ia angustifolia Michx.
mmon, sandy pine woods, occasional on clay.

nia Baldwini Torr.
llected once, Auburn.

*Vernonia flaccidifolia Small. 1.
Occasional, upland clay woods.

*Vernonia glauca (L.) Britt.
Collected once, Auburn.

†Vernonia maxima Small. 2.
Frequent, alder swamps, etc., reaching 10 or 12 feet.

*Vernonia Noveboracensis (L.) Willd.
Occasional, fields, pastures and roadsides.

*Vernonia ovalifolia T. & G. 3.
Common, dry sandy woods.

Willoughbia scandens (L.) O. Kuntze.
Common, climbing in swamps.

Xanthium glabratum (D C.) Britt.
(=*X.* strumosum.)

1.—Some of these specimens were at first determined as *V*[...] *nonia fascicularis* Michx. and are so reported by Mohr, Pl[...] Life, 758.

2.—This is the Vernonia gigantea (Walt.) Britt, reported fr[...] Clay county, Mohr, Plant Life.

3.—Distributed as Vernonia Drummondii.

No. 120. APRIL, 1902

ALABAMA.

ltural Experiment Station

OF THE

icultural and Mechanical College,

AUBURN.

OW PEA AND THE VELVET BEAN AS FERTILIZERS.

BY J. F. DUGGAR.

MONTGOMERY, ALA.,
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The Bulletins of this Station will be sent free to any citizen the State on application to the Agricultural Experiment Statio Auburn, Alabama.

HE COWPEA AND THE VELVET BEAN AS FERTILIZERS.

BY J. F. DUGGAR.

Summary.

This bulletin records the results of more than fifty ex-
eriments conducted at Auburn during the past five
ears, to ascertain the effects of cowpeas and velvet
eans in the improvement of the soil. The amount of
oil improvement has been determined by the increase
n the yields of cotton, corn, oats, wheat and sorghum,
rown as first, second, third or fourth crops after the
tubble and roots of cowpeas or velvet beans or after
ines, stubble and roots of these plants have been plowed
nder. The basis for determining this increase has
een the yield of each crop on plots where no leguminous
lant has recently grown.

The fertilizing value of different varieties of cow-
eas was found to vary considerably, and is probably in
roportion to the luxuriance of growth.

In two tests there was a slightly larger yield of corn
rom plowing in cowpea vines very late in the fall
han from postponing the plowing until April; but it is
egarded as generally best to plow in the vines not more
han a few weeks before the next crop is planted.

The average for six varieties showed that when cow-
eas were at a suitable stage for mowing 36.6 per cent.
nd in another case 39 per cent. of the dry weight of
he plant was available for fertilizing uses in stubble,
oots and fallen leaves. In the entire growth of cow-
eas on one acre there was contained in one case 53.7
ounds of nitrogen, in another 69.8, and in another
7.2, an average of 70.2 pounds of nitrogen per acre,

which is equivalent to the nitrogen in 1,003 pound
of cotton seed meal.

In the roots, stubble and fallen leaves on an acr
there were, respectively, 11.65, 16.2 and 31.4 pounds o
nitrogen, an average of 19.75 pounds of nitrogen pe
acre, which is equivalent to that contained in 282 pound
of cotton seed meal.

The average of three tests shows that 28 per cent. o
the total nitrogen was contained in the roots, stubbl
and fallen leaves after the removal of the hay.

The average increase in the yields of succeeding crop
was practically identical whether the fertilizing mate
rial was supplied by cowpeas or by velvet beans. Equa
areas of these two plants were of practically equal valu
for soil improvement.

The word vines is here used as synonymous with th
entire plant of the velvet bean, and with the entire plan
of the cowpea after the pods are picked.

The increase in the yield of seed cotton produced i
the year immediately following the plowing in of th
vines of cowpeas or velvet beans averaged in four test
567 pounds per acre, worth (at 6¾ cents per pound fo
lint and $7.50 per ton for seed) $14.17. The increas
in the first cotton crop after the use as fertilizers o
the vines of the summer legumes was never less tha
32 per cent. and averaged 63 per cent.

In one test with corn the increase in the first cro
where velvet bean vines had been plowed in was 8
per cent., of 12.3 bushels, worth at least $6.15 per acr
With oats the average increase from the vines of th
summer legumes in three tests averaged 17 bushels pe
acre, and with wheat the corresponding increase in tw
tests was 5.65 bushels per acre.

The increase in the yield of sorghum hay after cow
pea and velvet bean vines averaged 87 per cent., or a

gain of 2.1 tons of hay per acre, worth, at $6.67 $14.02.

the vines of the cowpea or velvet bean were is hay and only the roots and stubble employed zer the increase in the yield per acre of the crop tely succeeding the stubble was as follows:

of seed cotton, or 18 per cent., worth $5.20.
s of corn, or 32 per cent.;
s of oats, or 334 per cent.;
s of wheat, or 215 per cent.;
of sorghum hay, or 57 per cent.

rgest *percentage increase* from either the vines le of cowpeas or velvet beans was made by id fall sown oats, probably because these best l the washing away or leaching out of the fer- naterial in the stubble or vines of the legumes. illy on sandy soil those crops most completely ie fertilizing value of the legumes which leave unoccupied for the shortest interval. It is unadvisable for legumes to immediately suc- imes in the rotation of crops, for non-legumi- nts like cotton, corn, the small grains, grasses, ce better use of the nitrogen of the fertilizing

lue of the increased product resulting from the e entire legume for fertilizer was greater with id sorghum than with corn, oats or wheat.

experiments emphasize the importance of such n of crops as will require a large proportion iltivated land of every farm to be devoted to uminous plant.

ring the fertilizing effect of the vines with that ubble of the cowpea and the velvet bean, the the next crop in favor of the vines averaged s:

6.6 bushels of corn per acre, or.........49 per cent.
.5 ton of sorghum hay, or .... 9 per cent.
452 pounds of seed cotton per acre, or....40 per cent.

With these three crops the average increase in value per acre was $5.98 greater from vines than from stubble. With oats and wheat the vines of these summer legumes were not superior to the stubble when the small grains were sown immediately after the legumes matured.

The fertilizing effect of the *stubble* of cowpeas or velvet beans was very transitory on sandy land, the average increase in the second crop of corn after the stubble being only 1.34 bushels per acre, or 12 per cent., as compared with the yield of a plot that had not borne legumes.

The fertilizing effect of the *vines* of cowpeas and velvet beans was less transitory than that of the stubble, and the increase was 24 to 54 per cent. in the second crop, 14 per cent. in the third crop (oats), and the favorable effect was even perceptible in the fourth crop (sorghum) grown in the same year as the third. The total increase in value of the four crops occupying certain plots during the three years after the plowing under of the vines of cowpeas and velvet beans was $42.97 per acre, an annual increase of $14.32 per acre.

On the other hand, on very light soil the fertilizing effects of both stubble and vines had practically disappeared within twelve months after the plowing in of the legumes.

Corn as the second crop yielded 14 per cent., or 2.1 bushels more after legume vines than after legume stubble, this representing a value of $1.05. The permanency of effect of legumes in soil improvement seems to be in proportion to the stiffness of the soil and to the mass of vegetable matter afforded by the legume, and the favorable influence of leguminous vines is apparently not less permanent than that of stable manure.

INTRODUCTORY.

he improvement of the soil should be one of the
f aims of every farmer. Every increase in pro-
tiveness brings an even more marked increase in
its. Given rich soil, and almost any crop will pay if
pted to the local conditions and markets. Labor
nt in the cultivation of corn or cotton on extremely
r soil usually earns scant reward or none.

ortunately much of the poorest worn land can be
ight to a fair degree of productiveness. The means
soil improvement are various. Most thoroughly
ed by long experience in Europe and America is
: system of farming which depends for soil enrich-
it on the manure from a large number of livestock
ntained on the farm, partly for immediate profit,
largely for use as manufacturers of fertilizers. This
em should be much more generally followed in Ala-
ia. However, its introduction will be gradual be-
se of limited capital, inexperience, and the small
ıber and poor quality of the native livestock that
st serve as a foundation for stock raising.

[eantime the most immediately available method of
easing the fertility of the soils of the South consists
he free use of that class of leguminous plants, or
imes, which embraces cowpeas, velvet beans, soy
ns, beggar weed, peanuts, hairy vetch, crimson clover,
numerous others.

/hen these plants are grown under suitable condi-
is specific enlargements occur on their roots and these
called root tubercles, or root nodules. The micro-
pic organisms which live within these tubercles are
e to assimilate the nitrogen of the air that circu-
s through the upper layers of the soil. This nitrogen
le a part of the air was useless to plant life, but

within the tubercles it is changed into available fertil and is carried by the sap to every part of the legu nous plant. Hence we may speak of these tuber as fertilizer factories where nitrogenous fertilizers manufactured and whence they are sent to every of the cowpea or velvet bean, or other leguminous pl The plowing in of the legume gives this nitrogen the soil for the use of other plants. Nitrogen w purchased in the form of cotton seed meal costs 1 15 cents per pound, but when it is furnished by legu it is many times cheaper, the principal outlay being seed and labor.

Great as is the need of the South for varied in trial development, the factories most urgently ne and paying largest dividends are those which e farmer can bring into being by the millions on roots of such legumes as cowpeas, velvet beans, ve crimson clover, melilotus, bur clover, and alfalfa.

These crops afford nitrogen and vegetable ma thus supplying the principal deficiencies of south soils, and they may be either used directly and clusively for this purpose, or with greater profit tops may first be fed to livestock, thus affording a fold profit in animal products and fertilizer, while stubble and roots are immediately available for soil provement.

The stubble alone usually causes a sufficient incr in the yield of the following crop to more than pay cost of seed, fertilizer, and cultivation of the legu leaving the food value of the tops as a net gain.

The principal part of this bulletin is occupied data obtained at Auburn during the past five years bearing on the extent and permanency of the fertili effect of cowpeas and velvet beans.

The following conditions prevailed in all of these t unless otherwise specifically stated:

mes were grown in drills and cultivated and
fertilized with acid phosphate or with phos-
some potash salt. The crops, corn, cotton,
it, sorghum, and rye, used to measure the
effects of the legumes, have received no appli-
nitrogen, but have been fertilized with phos-
potash.

in all tests is rather poor to extremely poor
y upland, the white or gray being almost a
and the reddish soil approaching a loam with
m subsoil in the latter case.

es or stubble of the legumes have been plowed
before the planting of the next crop.

iety of cowpeas employed was the Wonderful
vn.

ng the crops the endeavor has been made to
vative average prices, the error, if any, be-
ting them too low rather than too high. Lint
s been rated at 6¾ cents per pound, cotton
50 per ton, sorghum hay at $6.67 per ton, corn
s, oats 40 cents, and wheat 80 cents per
No record is here made of the increase in the
rain, straw or corn stover, assmuing that this
about sufficient to cover the increased cost of
and threshing.

TIME TO PLOW IN COWPEA VINES.

ray sandy upland soil the vines of drilled
ere plowed under in the late fall of 1898 and
e on other plots plowing was deferred until
nting time.

ds of corn were as follows:

Bushels of corn per acre following cowpea vines plo under in late fall or early spring.

	Bus. per acre.		
	1899	1901	Av.
Fall plowed	23.8	30.6	27
Spring plowed	20.8	29.7	25
Difference	3.0	0.9	1

The results are slightly in favor of plowing ur peavines in the latter part of the fall rather thar spring. As the plots were not strictly uniform, fur experiments are needed before definite conclusions be drawn. It should be said that on July 5, 1899, foliage of the corn plant was much greener where vines had been turned under in the fall than on the o plots, though the ears were not discernably different

It is usually regarded as best to avoid fall plow on sandy land in the South unless a winter cro to be grown. On heavy soils where fall plowing otherwise be desirable, the legumes should first be lowed to mature.

Unless otherwise stated the time of plowing ur cowpea and velvet bean vines referred to in this bull is a few days or weeks before the planting of the crop that is to occupy the ground.

Relative Fertilizing Values of Different Varie of Cowpeas.

Corn was grown in 1898 and 1901 immediately lowing different varieties of drilled cowpeas which been picked and in spring the vines plowed under.

of yield of corn in bushels per acre on vine plots ompared in 1898 with no-legumes plot and in)1 with plot where only pea stubble had been plowed under.

Variety of cowpeas.	1898. Bus.	1901. Bus.
ıl (or Unknown)	2.7	0.6
rwill	2.9	—1.5
....	4.3	0.7
om Hastings		—2.9
per		5.9
....		—3.2
iant		0.6
hite		1.9
hite Crowder		5.3
....		6.8
e	3.3	1.4

e figures are given merely as a matter of record, conclusions are yet warranted. As a matter mon experience any variety of cowpeas affords ines as much or more nitrogen than the follow- n crop can utilize. For crops requiring a larger of nitrogen or for larger supplies of vegetable we may safely value the numerous varieties of s in proportion to the yeild of hay which they afford if thus utilized. As noted in Bulletin 118 rful (or Unknown), Clay, and Iron are among ieties making large yields of hay, and hence of ing material. The Wonderful, by reason of its eild, large stems and roots, and varied useful- s especially recommended for fertilizing pur- It is possible, however, that future investiga- ay show some advantage for varieties that run he ground and thus by the tangle of runners hold e on sloping ground in winter a larger propor- the leaves than is done by an erect variety like oorwill or Wonderful.

COWPEA VINES, EFFECT ON FOLLOWING COTTON OF 1899.

On a reddish loam upland soil of fair quality Wonderful cowpeas and cotton, similarly fertilize grown in 1898. The peas were picked, yieldir bushels per acre, and the vines were plowed und next spring, when both areas were planted wi ton. The corrected yield of cotton in 1899 w pounds, or 32 per cent. greater on the area whe peavines had been plowed in than on the plots wh preceding crop had been cotton.

Cowpea vines, residual fertilizing effect on crop, viz., oats grown in 1900.—Burt oats were s February, 1900, on the same plots as above to t residual or second-year effects of cowpea vine some plots the oats received no nitrogenous fer on others 76 pounds of nitrate of soda was us acre.

The yields of oats, in bushels per acre, were lows:

Fertilizing effects on oats of cowpeas grown two before.

	After cotton in '98 and '99	After cowpeas in '98 & cotton in '99.	Increase able to of
	Bus.	Bus.	Bus.
Yield of oats per acre with nitrate of soda..	19.7	25.5	5.8
Yield of oats per acre without nitrogenous fertilizer	12.3	22.0	9.7

In this case we have an increase of 9.7 bushels per cent., as the effect of cowpea vines on oats as the second crop after cowpeas. So strong wa

ing effect of cowpeas that it was not entirely
ed even when nitrate of soda was also employed,
rease in the yield of oats under these conditions
29 per cent.

peas as fertilizer on lime land.—A co-operative
er experiment was conducted for this Station
ot. A. A. McGregor on lime land at Town Creek,
th Alabama. In his experiment the cowpea was
gume employed.

898 cowpeas were grown on certain plots and cot-
others. The cowpea vines, on which no fruit had
ed, were plowed under in the spring of 1899.
was planted on plots which had borne a crop of
in 1898 and on others which had grown cowpeas
tilizing purposes. All cotton plots referred to
paragraph were unfertilized in 1899, and the
ation of cowpeas and cotton in 1898 had been
al, only phosphate having been used with either

weather was exceedingly unfavorable in 1899, so
e full measure of the fertilizing value of cowpeas
t revealed in this test.

his case the average increase in the yield of seed
which we may attribute to the cowpea vines is,
nder very adverse conditions, 58 per cent., or 125
s, worth at 2½ cents per pound, $3.92 per acre.
less later crops have also been benefited by the
ation with cowpeas.

re is reason to expect a larger increase than the
when cowpeas are plowed under on the lime lands
er the Tennessee Valley or of the Central Prairie
of Alabama. Especially in the prairie soils the
pal need is for vegetable matter to lighten the soil
add nitrogen, and for these purposes the choice
usually be made between melilotus (the so-called
) and cowpeas.

Fertilizing Effects of Vines of Cowpeas and V
Beans as Shown by Sorghum in 1897.

In 1897 sorghum was grown on three plots foll respectively, velvet bean vines plowed under, vines plowed under, and fallow, or clean cult without crop in 1896.

In 1897 the yields of sorghum hay per acre w follows:

	Yield. Lbs.	Incre Lbs.
After fallow	3,792	
After cowpeas, plowed in	7,008	3,216
After velvet beans, plowed in	7,064	3,272

The effect of the legumes was to nearly dou crop of sorghum hay.

Fertilizing Materials in Leaves, Stems, and
of the Cowpea.

In September, 1899, just 81 days after the p of the seed, samples were taken of six varieties peas growing in 34-inch drills on poor gray sand The sample in each case comprised the entire gro a measured area of land, including the roots grow the upper 6 inches of soil, which stratum co nearly all the roots.

After curing, the leaves, blooms and pods, stems ,fine stems (including runners, leafstalks fallen leaves and leafstalks,and roots with at stubble about two inches long, were carefully sep Analyses were made in the chemical departmen composite sample representing all six varieties, t terial analyzed being extremely dry. (For anal same samples showing food value see Alabama S Bulletin No. 118, page 37.)

e following table shows what percentage of the air-dry weight of the plants of each variety was able for fertilizing purposes after the removal of ay.

cent. of the entire weight of the cowpea plant in bble and roots and in fallen leaves and leaf stalks.

Variety.	Fallen leaves, etc.	Roots and 2-inch stubble.	Total.
	%	%	%
....	17.7	25.0	42.7
oorwill	3.7	21.6	25.3
....	15.4	19.0	34.4
erful	19.2	20.3	39.5
White	14.3	14.5	28.8
....	22.9	26.0	48.9
ge, 6 varieties	15 5	21.1	36.6

e average for the six varieties shows that in each pounds of dry plants there were 15.5 pounds of n leaves and leaf stalks, and 21.1 pounds of roots stubble, making a total of 36.6 pounds, more one-third of the entire plant being thus left on the nd for fertilizer after the hay was cut.

nalyses of the different parts of the plant made by . C. L. Hare, of the chemical department of this on, are recorded in the following table.

mposition of parts of the air-dry cowpea plant.

	Water.	Nitrogen.	Phosp'ric Acid.	Potash.
	%	%	%	%
s	10.65	3.59	.78	1.49
stems	8.97	1.90	.64	.68
e stems	8.47	1.51	.42	1.49
n leaves and leaf stalks	9.75	1.67	.37	1.09
and 2-inch stubble..	5.25	1.38	.26	1.11

t us direct our attention to the nitrogen, since this e only one of the three precious elements that the t obtains (in part) from the air, and the only one in

which the soil is enriched by the growing of cowp
The growing leaves in the air-dry condition con
nearly twice as large a percentage of nitrogen as
fine stems, and more than twice as much as the co
stems and roots and fallen material.

Amounts of air-dry material and nitrogen afforde
different parts of the cowpea plant on one acre
(average of six varieties)

	Air dry material.	Nitr
	Lbs.	Lb
In leaves retained on vines	501.0	
In fine stems	401.6	
In coarse stems	438.8	
In pods, blooms, etc	325.0	
In fallen leaves and leaf stalks	357.3	
In roots and 2-inch stubble	411.7	
Total	2435.4	

*Assuming 3% of nitrogen in thoroughly air-dry pods.

The amount of nitrogen stored up by a poor cro
cowpeas growing on an acre, 53.67 pounds, is equiva
to that contained in 767 pounds of cotton seed meal.
should be remembered that an undetermined portio
this nitrogen came from the soil, though on a soi
poor as this the nitrogen derived from the air prob
constituted by far the larger portion of the total ni
gen utilized by the plant.

In the stubble, roots, and fallen material there
11.65 pounds of nitrogen per acre or the same amo
as is contained in 162 pounds of cotton seed meal.

Of the total nitrogen in the entire plant 22 per c
was found in the roots, stubble and fallen material

An experiment somewhat similar to the prece
was made in 1900, using only a single variety, Won
ful or Unknown. The seed were planted in drills

't on poor gray sandy soil. Four samples were om two plots, each sample consisting of the rowth on an area of four square yards; the re obtained by digging and sifting the soil to of six inches, to which stratum all the principal re apparently confined.

he samples were accurately taken is indicated ose agreement of the duplicate samples; hence rage results are given below. The vines were fallen leaves and leaf stalks collected, and the ed out on September 5. This was 106 days after of planting on one plot and 78 days after plant-he other.

harvested the more mature sample was slightly prime for hay, as shown by the unduly large of fallen leaves, while the other sample was too e and succulent for easy curing.

elds per acre of extremely dry hay according to nt of the samples taken after being stored in an seven months, were 2,269 pounds on the plot late stage, and 2,087 pounds of the less mature These are equivalent to about $1\frac{1}{4}$ and $1\frac{1}{8}$ tons of cowpea hay with the usual amount of mois-

(air-dry) per acre of hay, roots, and stubble, and fallen leaves of the cowpea.

	Air dry material, per acre.	
	Ripening stage.	Blooming stage.
	Lbs.	Lbs.
iding stems, leaves, pods, etc	2,269	2,087
stubble about 2 in. long...	714	502
es and leaf stalks	1,385	804
....	4,368	3,393

The following table shows what proportion of the en- tire plant consisted of roots, fallen material, and ha in the plants harvested when ripening or when bloom.

	Ripening stage.	Bloomi stage.
	%	%
Tops	52	61
Roots and stubble	16	15
Fallen leaves, etc	32	24

When hay was made of cowpeas past their prin there was left on the ground in roots, stubble, and fall material 48 per cent. of the weight of the plant, ar when mowing occurred when the vines were in bloo 39 per cent. of the total weight remained as fertiliz material.

Analyses made by Prof. J. T. Anderson, Associa Chemist of this Station, are recorded below:

Composition of hay, fallen material, and roots and stubble of the cowpea.

	Water.	Nitrogen.	Phosph'ric Acid.	Potas
In ripening stage:	%	%	%	%
Hay	9.05	2.46	.85	2.
Fallen leaves and leaf stalks	7.80	1.83	.64	1.
Roots and stubble	7.77	1.17	.48	1.
In blooming stage:				
Hay	8.15	2.57	.81	2.
Fallen leaves, etc.	6.80	1.36	.59	1.
Roots and stubble	7.00	1.05	.41	2.

From this table it may be seen that the hay is mo than twice as rich as the roots and stubble in nitroge and also richer in phosphoric acid and potash.

The amounts of nitrogen contained in the hay, fall material, and roots and stubble on one acre were as fo lows:

	Ripening stage. Lbs. nitrogen.	Blooming stage. Lbs. nitrogen.
y	55.8	53.6
len leaves, etc	23.1	10.9
ts and stubble	8.3	5.3
al per acre	87.2	69.8

ie total amounts of nitrogen stored up by the cow-plant on one acre was in one case 87.2 pounds, in other 69.8 pounds, equivalent, respectively, to the gen in 1,246 and 997 pounds of cotton seed meal.

this amount there was left in and on the soil when ing occurred late 31.4 pounds of nitrogen; and from ounger plants 16.2 pounds per acre. This is equiva-to the statement that the nitrogen per acre remain-after the vines were removed was equal to the int contained in 446 or 231 pounds of cotton seed .

the total nitrogen in the plant, the roots, stubble, fallen material contained 34 per cent. at the ripen-stage, and 23 per cent. at the blooming period.

nsidering the three tests together the total amounts trogen per acre of cowpeas was 70.2 pounds in the e growth, of which the average amount in the ble was 19.75 pounds, or 28 per cent.

PEA STUBBLE VERSUS COWPEA VINES AS FERTILIZER FOR CORN IN 1901.

rn was grown in 1901 on sandy loam land, which, 900 had borne a light crop of drilled cowpeas, ted after the removal of the oat crop of 1900.

ree plots were employed. On one the peavines had cut the previous September, yielding 1,648 pounds ay per acre. On the other two plots no vines nor were harvested but the entire growth, which was

only about half of a normal yield, was plowed un
March 14, at which time the stubble plot was a
plowed.

On the stubble plot and on one of the others c
was fertilized with 100 pounds of acid phosphate
acre, which fertilizer was omitted from the third p
The stand was uniform. The yields of corn in busl
per acre were as follows:

	Bu
Pea stubble and phosphate as fertilizer	11
Pea vines and phosphate as fertilizer	20
Pea vines as fertilizer, no phosphate	21

The yield of corn following pea vines was 78 per c
greater than the yield on the plot where the stub
only had been plowed under, the increase being 8
bushels per acre.

In the presence of a considerable amount of rich ve
table matter furnished by pea vines, phosphate was
needed on this soil where acid phosphate had been
plied annually for many years.

In a different field on more permeable gray sa
soil corn grown in 1901 on a plot where the stubble
Wonderful cowpeas had been plowed under for
yielded 25.3 bushels per acre. The average yield
corn on two adjacent plots—where cowpea vines of
varieties Lady and White Giant, both luxuriant grow
had been plowed under, was 25.9 bushels per a
Here there was practically no superiority of vines o
stubble as a fertilizer for corn.

Note should also be taken of the increase in the c
crop due to plowing in either stubble or vines of a n
ber of varieties as recorded in the table on page 131.

...vet Bean Stubble and Vines as Fertilizers for Corn in 1901.

...e fertilizing effect of velvet bean stubble, of velvet ... vines, and of velvet bean vines in connection with ... phosphate, was tested in 1901 on four plots of very ..., deep white sandy soil. On one plot the proced... ...rop had been corn. On the other three plots drilled ...et beans planted June 13, after the harvesting of ...oat crop, had made only a moderate growth in 1900. ...one of these plots the velvet bean vines were cut ...ember 10, 1900, yielding 3,632 pounds of hay per ...

...n the other two plots the vines were left on the land ...winter. In the latter part of the winter all four ...s were plowed, a disc harrow having first been run ... the field while the vines were frozen in order to ...them and thus render it easier to plow them in.

...e corn on three of the plots was fertilized with 100 ...nds of acid phosphate per acre, but this fertilizer ... omitted on one of the plots where velvet bean vines ... been plowed in.

...d of corn in 1901 following corn, velvet bean stubble, or velvet bean vines.

	Bus.
...sphate (but no legume), as fertilizer......	13.58
...et bean stubble and phosphate as fertilizer..	17.93
...et bean vines and phosphate as fertilizer...	25.90
...et bean vines (no phosphate), as fertilizer..	21.48

...e increased yield per acre, as compared with the ...l on the plot on which the previous crop had been ..., was 4.35 bushels, or 32 per cent., with velvet bean ...ble, and 12.32 bushels, or 81 per cent., with velvet ... vines.

The increase attributable to 100 pounds of acid phosphate was 4.42 bushels, which made the use of mineral fertilizer decidedly profitable for corn on poor white sandy soil, when used in connection w large mass of rich vegetable matter. On the hand, on a spot about 100 yards distant, where soil was less sandy and in better condition, phosp did not increase the yield of corn when added to vines plowed under. (See page 140.)

IMMEDIATE FERTILIZING EFFECT ON SORGHUM OF CO AND VELVET BEAN VINES AND OF COWPEA AN VELVET BEAN STUBBLE.

The soil on which the following experiment was is a sandy loam, containing many small flint stones underlaid by a stiffer subsoil.

In 1898 eight uniform plots were planted, 2 with velvet beans, 5 with Wonderful cowpeas (plots broadcast), and 1 with drilled Orange sorg The growth of the several plots was either cured fo or used as a fertilizer, as indicated in the next table

March 9, 1899, all plots were plowed and in due sorghum was planted in drills on all plots, and th cuttings of this crop at the proper season were for hay.

The yields per acre of sorghum hay at two cutt the first growth having become too coarse, but th ond being of good quality, averaged as follows:

First year effects on sorghum of stubble or vines of peas or velvet beans.

	Yield per acre.	Increase legun
	Tons.	Ton
Sorghum hay after sorghum stubble..	3.65	
Sorghum hay after cowpea stubble..	5.66	2.0
Sorghum hay after velvet bean stubble	5.80	2.1
Sorghum hay after cowpea vine, pckd	5.72	2.0
Sorghum hay after velvet bean vines	6.76	3.1

ertilizer for sorghum velvet bean vines proved
to cowpea vines, and to velvet bean stubble.
ubble of cowpeas and of velvet beans was of
ly equal fertilizing value.

*fertilizing effect of legumes on corn grown as
cond crop after cowpea and velvet bean vines
wpea and velvet bean stubble.*

17, 1900, the sorghum stubble in the experi-
t discussed was turned with a one-horse plow
ch 29 corn was planted on all plots.

*ing effects in 1900 of stubble and vines of cow-
peas and velvet beans grown in 1898.*

in 1898.	Portion used for fertilizer.	Corn per acre in 1900.		
		Yield.	Increase over sorghum plot of 1898.	Increase, vines over stubble.
		Bus.	*Bus.*	*Bus.*
hum. .	Stubble...........	24.1	....	....
peas....	Stubble	25.7	1.6	....
peas	Vines. after picking	27.7	3.6	2.0
et beans.	Stubble..........	23.9	0.2	....
et beans.	Entire growth......	26.8	2.6	2.4

be noted that the heavy growth of sorghum in
not utilize all of the fertility derived from the
g crop of legumes. Although sorghum is a plant
specially exhaustive to soil fertility, there still
l for the corn crop of 1900 a residue of nitrogen
cowpea and velvet bean vines of 1898 sufficient
se the yield of corn to the extent of 3.6 bushels
where cowpeas had grown two years before,
bushels where velvet beans had grown. This is
ge of 3.2 bushels per acre as the residual fer-
effect of these legumes.

The fertilizing effects of the stubble and roots these two plants was far more transitory, the first s ceeding crop, sorghum, practically exhausting the leaving sufficient in the soil to increase the corn crop 1900 by only an inconsiderable amount, viz.: 1.6 bush and .2 bushel, an average of .9 bushel per acre." (Fr Bulletin No. 111, Alabama Experiment Station.)

IMMEDIATE FERTILIZING EFFECT ON CORN IN 190(OF COWPEA AND VELVET BEAN VINES.

This experiment was made on a white, sandy s poorer than that used in the last mentioned experime

In the late spring and early summer of 1899 vel beans had been planted in drills on certain plots a beggar weed had been sown broadcast on others. The b gar weed and a portion of the velvet beans was u exclusively for fertilizer. On other plots velvet bea were cut, thus leaving only the stubble as fertilizer corn.

"These various fertilizing materials were all plov under March 31, 1900, and Mosby corn planted Ap 5, using per acre 240 pounds of acid phosphate and pounds of muriate of potash.

Vines versus stubble of velvet beans as fertilizer fo corn in 1900.

Plots.	Material used for green manuring.	Yield of corn per acre.	Increa ove stubb plot
		Bus.	Bus
4 & 9	Stubble of velvet beans	15.6	
3 & 8	Entire growth of velvet beans	27.5	11.
2 & 7	Entire growth of beggar weeds........	18.7	3.

e entire growth of velvet beans afforded a yield of greater by 11.9 bushels per acre, or 76 per cent., the yield where only the stubble was employed as lizer." (Alabama Station Bulletin No. 111.)

lual fertilizing effects of velvet bean vines and ibble on the second crop of corn grown in 1901.

ne same poor, white, sandy hilltop was again ted in corn in 1901 without any nitrogen- fertilizer. The yield of corn per acre were 15 els where velvet bean vines growing in 1899 had plowed under and only 11.1 bushels where velvet stubble had been turned under at the same time. residual or second-year fertilizing effect of the vines greater than that of the stubble by 3.9 bushels per , or 33 per cent.

ne total fertilizing value of the vines during the two ons following the date when they were plowed in eded that of the stubble to the extent of 59 per cent., 5.8 bushels of corn per acre. This amount of corn ld usually be worth more than the net value of the) pounds of velvet bean hay obtained from the ble plot at considerable expense for curing.

this case it was more profitable to plow under vel- bean vines for fertilizer than to harvest them for Judging from other corresponding tests it would been still more profitable to have grazed cattle on vines, either in their green or winter-killed condi-

PEA AND VELVET BEAN VINES, IMMEDIATE FERTILIZING EFFECTS ON COTTON GROWN IN 1899.

1898 on a reddish loam soil, abounding in flint es and underlaid by a red loam subsoil there were vn on adjacent plots cowpeas, velvet beans, and cot-

ton, all fertilized alike with acid phosphate and kai
The cowpeas and velvet beans were planted thickly
drills, using per acre 112 pounds of cowpeas and
pounds of velvet beans. The variety of cowpeas u
was the Unknown or Wonderful. Both cowpeas
velvet beans were picked and removed from the fi
though the latter did not fully mature. The vines w
turned under in March, 1899, and all plots were plan
to cotton; each plot of cotton was fertilized at the r
of 240 pounds of acid phosphate and 96 pounds of ka
per acre.

The yield of seed cotton per acre in 1899 was 1,
pounds following cowpeas, 1,373 pounds following ve
beans, and 837 pounds following cotton.

These figures show that the increased yield of s
cotton attributable to manuring with cowpea vines
696 pounds per acre; the gain apparently due to
fertilization with velvet beans was 546 pounds per a
In percentages the increase is 83 and 64 per cent.,
spectively. Valuing seed cotton at 2½ cents per po
(which is equivalent to 6¾ cents per pound of lint
$7.50 per ton of seed), the gain with cowpeas and ve
beans is worth, respectively, $17.40 and $13.65 per a

Surely it was more profitable to grow cotton ev
alternate year at the rate of a bale per acre than
grow continuous cotton crops of about one-half bale
acre. Additional proof of this is found in the fact t
one of these plots afforded in 1898 a yield of 18¼ busl
of cowpeas per acre, besides increasing the cotton c
of the following year to the extent of $17.40 per acr

fertilizing effects of cowpeas and velvet beans orghum, oats, and late sorghum grown as second, third and fourth crops after these legumes.

same plots were planted with drilled sorghum any nitrogenous fertilizer in April, 1900; with without nitrogenous fertilizer in November, l again with drilled sorghum without any ni- s fertilizers, July 18, 1901.

g effects of cowpeas and velvet bean vines wn in 1898 on sorghum in 1900 and as a second crop in 1901.

eding crop.	Sorghum hay per acre, 1900.	Sorghum hay per acre. 1901.	Total increase after legumes.
	Tons.	Tons.	Tons.
98 and '99	5.1	1.0	
n '98 (picked), and '99	8.1	1.5	3.5
ns in '98, and cotton	8.2	1.6	3.7

pared with the plot not recently in legumes the of sorghum hay per acre in 1900 from cowpeas o years before was 3 tons per acre, or 59 per m velvet beans two years before the increase as 3.1 tons of hay, or 61 per cent.

creased yield with late sorghum, which was the op after the plowing in of the vines of the was, after cowpeas, .5 of a ton, and after velvet of a ton. In the two sorghum crops the total in yield attributable to legumes was, with cow- tons of hay, and with velvet beans 3.7 tons of per acre.

Now let us go back a few months and note the yi
of the oat crop coming between the sorghum crops
1900 and 1901.

Yield of oats in 1901 grown as the third crop afte legumes.

Preceding crops:	Yield, oats per acre.	Incre afte legum
	Bus.	Bus.
Cotton in '98; cotton in '99; sorghum in 1900	23.3	
Cowpeas in '98; do do	26.5	3.2
Velvet beans in '98; do do	37.2	13.9

The fertilizing effect of the legumes was appar
in the third crop after the legumes, the increase wh
cowpeas had once grown being 3.2 bushels of oats
acre, or 14 per cent. The increase where velvet be
had been is suspiciously large, and in subsequent cal
lations it will be assumed that the increase in the yi
on this plot if not influenced by accidental conditi
would have been no greater than that on the plot o
in cowpeas, viz., 3.2 bushels per acre.

Financial results of using cowpea vines as fertiliz for cotton, sorghum, oats, and late sorghum.

Let us convert these yields of cowpeas, cotton, s
ghum, and oats into their money values to le
whether the introduction of cowpeas or velvet beans i
the rotation has been profitable.

crops per acre in three years (1) following cot-ton and (2) following cowpea vines.

	Value of crops per acre in			
	1899.	1900.	1901.	Total for 4 crops in 3 years.
legume in 5 years:				
7 lbs. seed cotton, at 2½c*	$20.92			$69.93
.1 tons sorghum hay, 7 per ton		$33.02		
23.3 bus. oats, at 40c....			$9.32	
l ton sorghum hay			$6.67	
vpeas in '98, picked and lowed under:				
533 lbs. seed cotton at	$38.30			$112.90
3.1 tons sorghum hay....		$54.00		
26.5 bus. oats, at 40c....			$10.60	
.5 tons sorghum hay			$10.00	
in 3 years				$42.97
fference per year peracre				$14.32

› 6¾ cents per pound of lint, and $7.50 per ton of seed.

tal value of the products grown in three years re was $69.93 on the plot where no legume had wn for many years and $112.90 per acre on where one crop of cowpeas had been grown once ears, and where the vines, after the picking of had been plowed under at the beginning of the r period under consideration. The difference lue of the crops for three years is $42.97; the nnual difference is $14.32 per acre in favor of where cowpeas had been grown

ures showing the financial advantages of using of velvet beans for fertilizer during the same nearly correspond with those for cowpeas that lation need not be repeated.

s land the plowing under of the vines of the nd velvet beans was exceedingly profitable. The

soil of these plots is a reddish, clayey loam, stiffer a probably more retentive of fertilizer nitrogen a humus than the greater portion of the soil on the S tion Farm.

Lest any should misapprehend the lessons of this periment it is necessary to state that at no time in t three-year period was any nitrogenous fertilizer appli to any crop on any of these plots, but that each crop w supplied with phosphate and potash.

The yearly application of cotton seed meal would ha lessened the differences between the plots, as it has do in our unpublished rotation experiments, and wou have made the advantage in favor of legumes le striking than in the exhibit above.

Immediate Fertilizing Effects on Cotton of Velv Bean Vines.

On poor soil at Auburn an effort was made in 18 and 1899 to ascertain the manurial value of the vin and stubble of velvet beans.

In 1898 cotton was grown on certain plots and velv beans on others. The fertilization of all plots in 18 was not identical, but for a given fertilizer applied cotton there was a plot of velvet beans receiving t same fertilizer. The velvet beans grew in drills 3½ fe apart; the vines formed a dense mat of vegetation, b did not mature seed. In March, 1899, velvet beans an cotton stalks were plowed in and soon afterwards a plots were fertilized alike with a mixture of 240 poun of acid phosphate and 40 pounds of muriate of pota per acre.

Russell cotton was planted in 3½ feet drills on a plots on April 21. From midsummer forward there w a remarkable difference in the appearance of the tw

of plots, the cotton plants being much larger, er, and more luxuriant on the plots where velvet had grown the year before.

ield of seed cotton per acre following vet bean vines	1,578 lbs.
ield of seed cotton per acre following ton	918 lbs.
ncrease from velvet bean vines.......	660 lbs.

e average increase attributable to velvet beans used fertilizer was 660 pounds of seed cotton per acre, a of 72 per cent. as compared with the average yield lots where the preceding crop had been cotton. cents per pound of seed cotton (equivalent to nts per pound for lint and $7.50 per ton for seed) ncrease is worth $16.50 per acre.

sidual fertilizing effects on corn of velvet bean vines.

e residual ,or second-year, effects were tested on planted on these plots March 29, 1900, without genous fertilizer.

ere cotton had grown in 1898 the yield of corn in was 18 bushels per acre; on the next plot, where beans had been grown for fertilizer in 1898, the of corn in 1900 was 25.5 bushels. This gain of ushels per acre, or 42 per cent., represents the residual or second-year effect of using the entire growth of beans as a fertilizer.

DIATE AND RESIDUAL EFFECTS OF VELVET BEAN STUBBLE ON COTTON AND CORN.

the same field the velvet beans on one plot were or hay October 12, 1898. The stubble and roots

were plowed in at the same time as the vines on other plots referred to above.

Cotton on the plot where only roots and stubble w plowed in yielded in 1899 1,126 pounds of seed cot per acre, an increase when compared with the p where cotton had grown the previous year of pounds, or 49 per cent.

Comparing velvet bean vines with velvet bean stu the difference in favor of the vines was 452 pou of seed cotton per acre in the first crop.

Corn in 1900 on this plot yielded 14 per cent., or bushels per acre more than did corn on the nearest where in 1898 cotton instead of velvet beans grown. As the stubble plot was slightly lower dow the hillside we suspect that the increase was partly to this disturbing condition and not wholly to the sidual effects of the velvet bean stubble of 1898.

It was on this stubble plot that in 1898 the ve bean hay (8,240 pounds per acre) contained 1 pounds of nitrogen and the roots and stubble and fa leaves only 12.5 pounds of nitrogen per acre. (See bama Station Bulletin, No. 104, page 336.)

IMMEDIATE FERTILIZING EFFECTS OF COWPEAS ON OATS IN 1897.

"On sandy soil in 1896 several plots were sown br cast with the Wonderful variety of cowpeas, and adjacent plot was sown broadcast with German mi The German millet was plowed under, as were also peavines, the peas having been previously picked.

February 18, 1897, Red Rust Proof oats were s after the above mentioned crops, using in both c 100 pounds of acid phosphate and 80 pounds of nit of soda per acre.

cowpeas the oat straw grew to be three to four
aller than on the plot preceded by German
The yields were as follows:

following cowpeas and German millet, 1897.

	Yield per acre.	
	Bus. Grain.	Lbs. Straw.
cowpeas, vines plowed under.....	22.8	788
German millet, plowed under.....	12.4	559
e per acre	10.4	229

case cowpeas were more valuable than Ger-
et as fertilizer for the following oat crop, the
e in favor of cowpeas being 10.4 bushels of
acre and 229 pounds of straw." (From Bul-
95, Alabama Experiment Station.)
an increase of 84 per cent. in grain.

TE FERTILIZING EFFECT OF COWPEA AND VELVET
N VINES AND STUBBLE ON OATS IN 1898.

xperiment is descibed in the following quota-
Bulletin No. 95 of this Station:
14, 1897, on poor sandy soil Wonderful cow-
e sown on two plots, velvet beans on two plots,
nan millet on a fifth plot. A sixth plot was pre-
d fertilized but left without seed, to grow up
grass, poverty weed, etc. Cowpeas and velvet
re sown in drills two feet apart, German
oadcast. The millet was cut for hay July 16,
994 pounds per acre. The cowpeas on one plot
ked September 10, yielding 11 bushels per

lvet beans did not mature seed.
tember, 1897, cowpeas on one plot and velvet

beans on one plot were cut for hay and the stubb plowed under. The vines of cowpeas on one plot ar of velvet beans on another were also plowed under the above mentioned date. Then oats were sown at uniform rate on all four plots, also on the plot whe the German millet stubble had been plowed under ar on the one where crab grass and various weeds had ju been buried by the plow.

On all plots oats were fertilized with 220 poun per acre of acid phosphate and 44 pounds of muriate potash, no nitrogen being supplied except that co tained in the remains of preceding crops of cowpea velvet beans, etc.

FIGURE 1. Oats following cowpea stubble on the right; on the l oats after crabgrass.

icre of oats grown immediately after stubble vines of cowpeas, velvet beans, etc.

	Yield per acre.	
	Grain.	Straw.
	Bus.	Lbs.
velvet bean vines..................	28.6	1206
velvet bean stubble..............	38.7	1672
after velvet bean vines and stubble	33.6	1439
cowpea vines	28.8	1463
cowpea stubble	34.4	2013
after cowpea vines and stubble....	31.6	1738
crab grass and weeds	7.1	231
German millet	9.7	361
after non-leguminous plants......	8.4	296

rly spring there was a marked difference in ance of the several plots, the plants being ner and taller where either the stubble or wpeas had been plowed under.

e oats began to tiller, or branch, the differ- ased, the plants supplied with nitrogen, e decay of the stubble or vines of cowpeas beans, tillering freely and growing much the plants following German millet or crab e difference in the height and thickness of some of the plots is shown in figures 1 and 2. 1898, oats on all plots were cut.

xperiment the average yield of oats was 33.6 er velvet beans, 31.6 bushels after cowpeas, 4 bushels after non-leguminous plants (crab ls and German millet.)

a gain of 24.2 bushels of oats and nearly hs of a ton of straw as a result of growing or soil-improving plants, instead of non- plants, during the preceding season.

Undoubtedly this is an extreme, and not an avera
case. If cotton seed meal, or other nitrogenous f
tilizer, had been used on all the plots of oats, the pla
on plots 2 and 5 would have made better growth, a
the difference in favor of the leguminous plants wo
have been reduced.

A gain of five to fifteen bushels of oats per acre
a result of plowing under cowpea stubble or vines wo
make the growing of cowpeas for fertilizer a profita
operation, and it is far safer to count on such an
crease as that obtained in our first experiment (1
bushels), rather than to expect such an exceptional
crease as that obtained in this last experiment.

An unexpected result of this experiment is the lar
crop on the plots where only the stubble was left t
on those where the vines of cowpeas and velvet be
were plowed under. The plots were of nearly unifo
fertility, as judged by the location and by the unifo
growth of cotton on all plots in 1896. While admitt
the possibility that the two west plots (plots 3 and
were slightly richer than the two on the east (p
1 and 4), the writer thinks that the difference in y
was almost wholly due (1) to the fact that the vi
(especially those of the velvet beans) were not pr
erly buried by the small plow employed, and (2) t
the seed bed for oats was more compact where o
stubble was plowed under, a point of advantage, dou
less, in such a dry winter as that of 1897-98. It d
not follow that the land will be permanently b
efitted by cowpea stubble to a greater extent t
by cowpea vines. The reverse is probably true." (Fr
Bulletin No. 95, Alabama Experiment Station.)

ertilizing effect on late corn of cowpea and velvet bean vines and stubble.

e 20, 1898, or a month after the harvesting of n the last mentioned experiment, all six of s were planted in corn without nitrogenous on, which crop, as usual with very late corn pland, was a failure.

lds were as follows:

of late corn grown as the second crop after legumes.

:	Yield per acre.	Increase after legumes.
	Bus.	
plowed in	4.3	
et, stubble plowed in	7.3	
ubble plowed in	6.2	.4
; stubble plowed in	7.7	1.9
ked; vines plowed in	6.7	.9
; vines plowed in	7.9	2.1

tilizing effects of both stubble and vines of was scarcely perceptible in the late corn ight months after and harvested thirteen ter the plowing under of the large amounts of furnished by the legumes. Apparently the re was not due to deficient rainfall, for this e except for about two weeks about the middle . The small size of stalks leads to the sus- at there was a deficiency of nitrogen on all this nitrogen was lost by being leached out ining water this loss must have occurred al- rely after corn was planted or in July and or in 1898 April, May, and June were unusu- months. On the other hand there was a excessive rainfall July 4 to 11 and of still cess July 28 to August 6. During this latter

period 7.59 inches of rain fell in a space of ten day

The experiment seems to teach that on very l gray, sandy upland, subject also to surface washing fertilizing effects of even large amounts of nitrogen nished by preceding crops of legumes may be rem from the soil within twelve months after the leg has been plowed in. The lesson might also be d that on such soils the planting of any non-legumi crop after small grain is risky, but that if such a is employed the seed should be put into the gr as soon as possible after the removal of the grain

An experience like this in which the fertilizing e of the entire or nearly entire growth of the leg was no greater than that of the stubble on either first or on the second succeeding crop emphasizes wisdom of utilizing the vines of cowpeas, etc., for leaving only the roots and stubble to fertilize the crop.

IMMEDIATE FERTILIZING EFFECT ON WHEAT OF COV AND VELVET BEAN VINES AND STUBBLE.

All the plots of the last mentioned experiment in oats from February to June, 1900.

June 23, 1900, certain plots were planted with dr cowpeas, certain others with drilled velvet beans, yet others were merely plowed and fertilized minerals, as were the legumes.

Of the two plots of cowpeas, one was cut for yielding 2,004 pounds per acre; on the other 7.9 bus of seed per acre were picked. One plot of velvet b was cut for hay, while on the other the vines were on the ground for fertilizer. The cowpea plants, riety Wonderful, were somewhat injured by a fun disease of the roots; velvet beans, by reason of late

planting and deficiency in stand, did not make an en-
rely satisfactory growth.

November 9 all plots were plowed, turning under
ther volunteer grass and rag weeds, or cowpea vines,
velvet bean vines, or cowpea stubble, or velvet bean
ubble. The plowing was poorly done with a one-
rse turn plow and in sowing the wheat a few days
ter some of the velvet bean vines were pulled up. The
heat received only mineral fertilizers, and, indeed,
actically no nitrogen had been applied to these plots
r three years.

The yields of wheat in 1900 were as follows:

*Bushels of wheat per acre after leguminous and non-
guminous crops:*

Crop in 1899.	Yield per acre.	Increase by use of legumes.	
	Bus.	Bus.	%
ab grass and weeds; plowed in	3.1		
wpeas; stubble plowed in	11.8	8.7	280
lvet beans; stubble plowed in........	7.8	4.7	151
wpeas, picked; vines plowed in	9.0	5.9	190
lvet beans; vines plowed in........	8.5	5.4	174

Both the stubble and the vines of the legumes prac-
ally trebled the yield obtained on the plots where no
gume had grown. The stubble was at least as effect-
e as the vines, pointing to the greater economy of uti-
ing the vines for hay or pasturage.

June 19, 1900, all these plots were planted with Mos-
corn, fertilized only with phosphate and muriate of
tash. The crop was a failure on all plots, the yield
cured fodder corn ranging from 1,540 to 2,200 pounds
r acre, the plots where vines had been plowed in the
evious fall showing no superiority over the stubble
ots, and very little increase as compared with the
ot where no legume had grown. It is impossible to
certain whether the failure with corn was due to the

protracted drought during almost the whole of July o
to the leaching out of the nitrogen of the legume
during the last few days in June, when 5.20 inche
of rain fell within a period of four days. The latte
explanation seems more probable in view of the fairl
favorable rainfall after August 1, 1900, and because o
similar failure of the late corn crop on the same fiel
in 1898, when there was no long period of drought, bu
a brief one of even more excessive rainfall.

The history of these six plots for these four year
ending with 1900 as just detailed shows very plainl
that the fertilizing effects of nitrogen very quickly di
appear on this light sandy sloping field, not underlai
by a clay or clayey loam subsoil; and that on such soi
the stubble of cowpeas or velvet beans was as efficien
as the vines, not only for the immediately succeedin
crop, but for later crops as well. This narrative shoul
add force to the recommendation we have so often give
that as far as possible the stems, foliage and seed o
legumes be utilized as food for animals and only wha
remains be employed as fertilizer.

Fertilizing Effects of Velvet Beans, and Peanuts as Compared with Corn, Sweet Potatoes and Chufas.

On a gray sandy upland soil, free from stones and un
derlaid by a sandy subsoil, various crops were grown i
1899, for the double purpose of comparing them as t
the amount of hog food produced and as to their e
fect in enriching or depleting the soil. The chufa
and a part of the Spanish peanuts were consumed b
shoats penned on the field. As the running variety o
peanuts failed this season to make any nuts the lux
uriant growth of vines was plowed under in the fal
as was also done with the vines of velvet beans and wit

es after the latter had been picked. Only corn were removed from the land, and only f sweet potatoes.

n broadcast on November 13, 1899, on all employed as the crop for determining what various summer crops had exerted on the the soil. The fertilizer for rye consisted of ng amounts per acre:

ds of cotton seed meal.

ds of ammoniated acid phosphate.

ds of muriate of potash.

ts of the legumes as fertilizers for rye would nore striking if no cotton seed meal or amuano had been employed, but the poverty of soil made some nitrogen indispensible if abre of crop was to be avoided on the plots t potatoes, chufas and corn had grown.

vas cut April 13 and April 16, and the green nce weighed. No second cutting of rye was he land was turned to other uses.

ye following sweet potatoes, corn, chufas, eanuts, cowpeas and velvet beans.

Preceding crop.	Yield per acre.	Increase from legumes as compared with sweet potatoes.	
	Lbs.	Lbs.	%
eet potatoes dug (av. 2 plots)..	2360		
n, ears pulled	3440	1080	41
ifas, eaten on the land........	4560	2200	93
anish peanuts; dug and only ed	3440	1080	41
nish peanuts; eaten on the land	6640	4280	181
ippoorwill cowpeas, drilled and eased)	4960	2600	110
vet beans, entire growth plowed ts)	5720	3360	142
lvet beans, nearly mature pods s plowed in	4720	2360	100
inning peanuts, entire growth av. 2 plots)	5212	2852	121

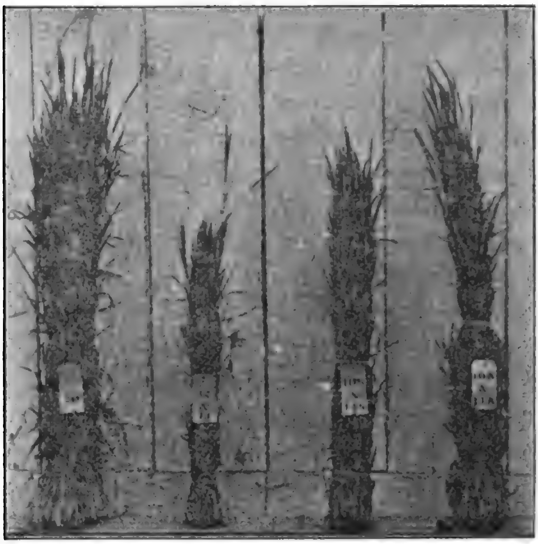

FIGURE 2. Rye from equal areas, following (20 velvet beans: (12 & 13) sweet potatoes; (10 S & 11 S.) corn; (10 N. & chufas hogged

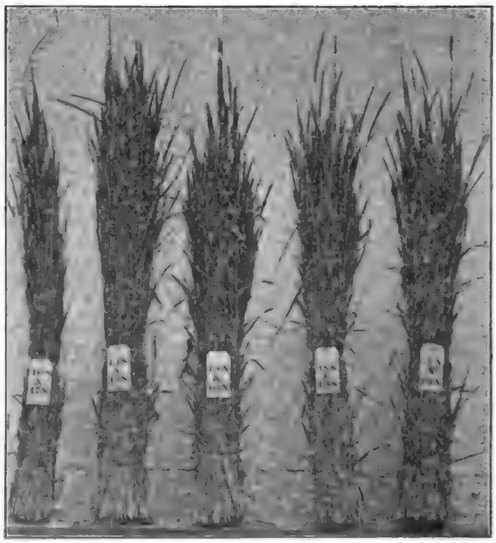

FIGURE 3. Rye from equal areas, following (16 S. & 17 S.) S peanuts, dug; (18 S. & 19 S) cowpeas; 14 N. & 15 N.) ru peanuts.

nes increased the yield in every case as com-
sweet potatoes, the excess ranging from 41
cent. Among the non-leguminous plants
oes was most exhausting to the soil, and
en consumed on the land, the least. This
common observation. In this case the ex-
fects of the sweet potatoes were not due to
the disturbed soil, for all plots were plowed
the potatoes were dug.

he legumes the greatest increase, 181 per
btained on the plot where Spanish peanuts
onsumed on the land by hogs. Since the
nuts here was not excessive, since the growth
only moderate, and since the vines of Span-
on an adjoining plot did not greatly in-
yield, we can attribute the increase where
razed, only to an assumed quicker nutrifica-
material that had passed through animals.
inds further support in the fact that chufas
by hogs on the land left the soil in better
han did either corn or sweet potatoes.

the entire growth of the several legumes
the land, with or without being utilized as
he succeeding yield of rye was more than

as grown in 1899 on a plot adjacent to the
The rye following cotton yielded 5,560
acre, but it is not fair to compare this yield
following the legumes, because the cotton
ery heavily fertilized, and some of this fer-
ably remained in the soil to be utilized by

Fertilizing effects of legumes on sorghum grown as second crop.

To ascertain what differences still existed in the as a result of legumes grown in the summer of 18 sorghum was sown in drills on this same field June 1900, all plots being uniformly fertilized with a phosphate. So that sorghum thus becomes the sec crop after the various legumes, and is intended to veal the residual or "left over" effects of the sum crops of 1899.

Residual fertilizing effects on sorguhm, of pean cowpeas and velvet beans.

Preceding crops. Summer of 1899.	Preceding crops. Winter, 1899, 1900.	Yield sorghum hay per acre.	Incre from umes comp wit swe potat
		Lbs.	*Lb*
Sweet potatoes, dug	Rye	5360	
Corn, ears pulled	Rye	5760	4
Spanish peanuts, dug; nuts removed	Rye	4480	los
Spanish peanuts; eaten on land	Rye	4000	los
Cowpeas, picked	Rye	5760	4
Velvet beans, all plowed in	Rye	7110	17
Velvet beans, pods picked	Rye	7600	22
Running peanuts, all plowed in	Rye	6320	9
Cotton, heavily fertilized	Rye	4000	los
Av., potatoes, corn, cotton	Rye	5040	
Av., velvet beans, cowpeas, running peanuts	Rye	6697	16

Evidently rye had not exhausted all the fertiliz value of the legumes. This second crop was favora affected by all the legumes except by Spanish peanu the benefits of which had disappeared. The average crease on the plots where all the other legumes grown the preceding summer was 33 per cent. as c pared with the yield on the plots where corn, cotton sweet potatoes had constituted the summer crops 1899.

ELATIVE FERTILIZING VALUES OF THE COWPEA AND VELVET BEAN.

Vhen tested on a number of crops, each grown *im-liately after* the legumes, the percentage increase as ipared with corresponding plots that had borne no ıme was 128 per cent. from peavines, and also 128 cent. from velvet bean vines. Additional weight is en to these figures since they represent the average ix tests with each plant. Continuing the inquiry as heir comparative value, we find that the second crop er cowpea vines showed an increase of 37 per cent. the second crop after velvet bean vines an increase 18 per cent. This is the average result of two com-able tests with each plant.

omparing these two plants with reference to the ilizing effect of the stubble on the first crop we find the average of three tests an increase that is ctically the same for the two plants.

ombining the results for the vines of each legume as wn in the first and second succeeding crops with the nediate results from the stubble of each we must clude that at Auburn the fertilizing values of the pea and velvet bean are practically equal. This rue for an acre of each. In the stubble plots the rage yield of velvet bean hay has been the greater, t is 4,781 pounds per acre of velvet bean hay against 78 pounds of cowpea hay, so that apparently pound pound the cured tops of cowpeas have been some-ıt more effective than the vines of velvet beans. s is in practical accord with the results of chemical lyses made at this station by Dr. Anderson, who lyzed peavine hay and velvet bean hay from ts where the stubble was used as fertilizer. found 2.29 per cent. nitrogen in velvet bean

vines and 2.46 per cent. of nitrogen in the c
pea vines, both samples containing 9 per cent. moist
The nitrogen in the two stubbles was practically eq
1 per cent.

Let us now consider the results as a whole, combin
those for the two plants and assuming that the ferti
ing value of cowpea vines and of velvet bean vines
equal, and that the stubble of the one plant is as
fective as that of the other. In what follows the figu
express the average results for cowpeas and vel
beans considered together under the name of sum
legumes.

Increase in the First Crop After Plowing in th Vines of Summer Legumes.

With cotton as the first crop the increase in seed
ton per acre at Auburn was respectively 367, 546, 6
and 660 pounds of seed cotton per acre. This is
average increase of 567 pounds, worth at $2\frac{1}{2}$ ce
(equal to $6\frac{3}{4}$ cents for lint, $7.50 per ton for see
$14.17.

The yield of *seed cotton* following the vines of
summer legumes exceeded that on plots where the p
ceding crop had been cotton to the extent of 32, 64,
and 72 per cent. *The average increase in the yield
seed cotton attributable to the vines of the legum
was 63 per cent.*

With *corn* as the first crop, the increase per acre
tributable to plowing in the entire growth of vel
beans was 81 per cent. or 12.3 bushels, worth, at
cents per bushel, $6.15.

With *oats* as the first crop, the effect of the vines
the summer legumes is seen in an increase per acre
10.4, 20.2, and 20.4 bushels respectively. The aver

ease per acre was 17 bushels, worth at 40 cents per el, $6.80. *The increase in the first crop of oats summer legumes was* 81, 240 and 242 per cent., *verage of 189 per cent.*

ith *wheat* the increase was 5.4 and 5.9 bushels, an age of 5.65 bushels per acre, worth at 80 cents per el, $4.53. *The increment was* 174 and 190 per cent. ectively, an average gain of *182 per cent.*

ith *sorghum* grown as the first crop after the plow-under of the vines of cowpeas and velvet beans, the ease in hay per acre was 1.6, 1.6, 2.07, and 3.11 tons, verage gain per acre of 2.1 tons of hay, worth, at 7 per ton, $14.02. The percentage gains were 85, 86, nd 86, respectively, *an average of 78 per cent.*

CREASE IN THE FIRST CROP AFTER PLOWING IN THE STUBBLE OF COWPEAS AND VELVET BEANS.

ith *cotton* the yield was greater after velvet bean ble than after cotton to the extent of 18 per cent., 08 pounds of seed cotton per acre, worth, at 2½ s per pound, $5.20.

ith *corn*, the stubble of velvet beans afforded a of 32 per cent. or 4.3 bushels, worth $2.15.

ith *oats* grown after the plowing in of the stubble hese summer legumes the increase was 30.3 and 26 els, or an average of 28.1 bushels per acre, worth 24. This is an average gain of 334 per cent.

ith *wheat* following the stubble of cowpeas and et beans the increase was 4.7 and 8.7, *an average of bushels per acre, worth* $5.36. The gain amounted 51 and 280 per cent. respectively, an average of 215 cent.

ith *sorghum* the yield of hay was increased by the

stubble of the legumes to the extent of 2.01 and tons, an average of 2.08 tons of hay per acre, valu $13.87. *The average increase was 57 per cent.*

WHAT CROPS WERE MOST FAVORABLY AFFECTED BY VINES OR STUBBLE OF COWPEAS AND VELVET BEAN

The data in the following table answer this que

Increase in first crop attributable to vines or stubl cowpeas and velvet beans.

TEST CROP.	After Legume Vines.			After Legume St		
	No. of Tests.	% In-crease	Value of Increase	No. of Tests.	% In-crease.	V c
Cotton	4	63	$14.17	1	49	
Corn..	1	81	6.15	1	32	
Oats..	3	189	6.80	2	334	
Wheat	2	182	4.53	2	215	
Sorghum..	4	78	14.02	2	57	

The percentage increase attributable to eithe vines or stubble of cowpeas and velvet beans was gr with fall oats and wheat than with cotton, cor sorghum. In other words, the *crop that was best to utilize the nitrogen of the legumes was that which left the land unoccupied for the shortest tim tween the maturing of the legume and the beginni the new growth.* Unpublished parallel experin with hairy vetch employed as fertilizers co this latter conclusion. All the facts befor indicate that after the vines or stubble of gume are plowed under in a sandy soil the seed o succeeding crop should be planted before the lap many weeks. The early occupation of the soil by of the young plants will serve to retain much nitr which would be leached out and carried away i drainage water if the ground should remain unocc for several months.

om what has just been said it should not be infer-
hat we are advocating the sowing of the small
s or of any small seed immediately after plowing
arge mass of vines. Instead, sufficient time should
ren for the soil to become somewhat settled by the
n of the rain or of harrow, drag, or roller. Small
and still smaller seed can usually be sown after
rter interval where the vines of the legume are uti-
for hay or pasturage, leaving only the roots and
le to be incorporated, than where the entire
h of the legume is turned under in the fall for fer-
r.

plowing under of cowpea vines takes place after
tmas the mass of vegetable matter will have be-
so diminished and the stems so weak that the de-
sowing to permit of the compacting of the earth
d the vegetable matter will be less necessary, or
ps unadvisable. But this interval may be quite
sary with velvet bean vines at whatever time they
lowed under, for the mass of matter will be con-
ble and the material is apt to be buried in large

ferring again to the last table, we see that while
mall grains gave the largest percentage increase
the use of a preceding summer legume as ferti-
the value of the increase was greatest with cotton
orghum hay. In other words, *cotton made more
able use of either the vines or stubble of the sum-
egumes on sandy land than did either corn, oats,
eat.*

rghum responded freely to the abundant supply of
gen in the legumes, and it may be accepted as a
ughly tested proposition that on poor or medium
ny hay plant of the grass family will return a
profit for a judicious application of nitrogen,

whether this be in the form of a preceding crop of peas, velvet beans, melilotus, hairy vetch, or crin clover, or in an application of stable manure, co seed, cotton seed meal, or nitrate of soda.

ROTATION OF CROPS THE FIRST STEP IN SOIL IMPR MENT.

The general statement may be safely made that ordinary crop (except peanuts, cowpeas and most o legumes) can usually be produced with far gre profit when it follows some leguminous plant than w its predecessor is some non-leguminous plant, as cot corn, the small grains, etc. It may also be added many, if not most, poor tracts of land can be cultiv in the usual farm crops at a profit only when a leg is occasionally grown to supply the necessary nitro vegetable matter, and improvement in texture and sistance to drought.

A more general use is urged of some rotation tha quires all the cultivated upland of the farm to cowpeas or other soil-improving plant every sec third or fourth year or oftener. The growing of legu constitutes the cheapest means of obtaining nitroger fertilizers, and on farms where a large proportion of land is devoted to legumes, the fertilizer bills can b duced by the discontinuance of purchases of cotton meal and by the substitution of high grade acid p phate for the higher priced ammoniated guanos.

A highly satisfactory rotation for cotton pla tions, which has been widely tested, consists of th ternation in the order named of cotton, corn, and one of the small grains, with cowpeas between the rows and also immediately following the small gra This three-year rotation gives one-third of the

ch year in cotton, the cotton immediately following wpeas sown after small grain. One-half the total ea can be devoted to cotton by a four-year rotation this plan, as follows: Corn with cowpeas, small grain llowed by cowpeas, cotton, and cotton.

HE AVERAGE IMMEDIATE FERTILIZING EFFECTS OF VINES AS COMPARED WITH STUBBLE OF COWPEAS AND VELVET BEANS.

Although in the last table a comparison of the perntage increase after vines with that after stubble is t strictly legitimate since the number of tests was equal, yet that table throws some light on the mat-r.

A strictly accurate comparison of the fertilizing ef-cts of vines and stubble as measured by the crop im-ediately following is shown below; in this table only ose experiments are recorded where corresponding ne and stubble plots were under identical conditions soil, date of planting, etc.

ncreased percentage of vine plots over stubble plots.

	No. of tests.	%
th cotton as first crop	1	40
th corn do	4	49
th oats do	2	[31]*
th wheat do	2	[20]*
th sorghum do	2	9

*Yield after legume stubble 31 and 20 per cent. respectively eater than after vines, the latter leaving the land too loose, a con-ion that could probably have been avoided by better preparation.

In the crop immediately following the legumes the nes afforded the larger yield except when accidental rcumstances reversed this result with wheat and oats. is excess in the first crop due to plowing under the

vines was here considerable, but was it sufficient t make this method of disposing of the vines more profi able than to use them for hay?

Of the several factors on which the answer depend we will first consider the value per acre of the increa in the first crop immediately succeeding the legum using the values for a unit of each crop heretofore a sumed (see p. . . .) and omitting results with sma grains, for reasons given in the footnote.

Average superiority of vines over stubble of legumes shown in first crop.

	No. of tests.	Increase per acre.	Value of in-crease	% in-crea
With cotton as first crop.	1	452 lbs. seed cotton	$11.30	40
With corn as first crop	4	6.6 lbs. corn.	3.30	49
With sorghum as first crop. . .	2	.5 ton hay.	3.34	9
Average in favor of vines over stubble	. . . . . .	. . . .	**$5.98**	

The average increase of $5.98 in the value of an ac of the first crop in favor of plowing in the vines compared with utilizing only the stubble for fertiliz is evidently so low as to be much less than the value the 4,030 pounds of legume hay per acre obtained fro the stubble plots, which should be priced at not less th $10 per ton. As a partial offset we must bear in mi that in four of the experiments in plowing under co pea vines the peas were first picked, the average yie in these tests being 11.1 bushels per acre. There is such corresponding offset with velvet beans, for the se usually do not mature in the latitude of Auburn.

If we value cowpeas at 50 cents per bushel, plus t cost of hand-picking, we have a second credit for t vines, the sum being $5.55. Adding this to $5.98, t

ra value of the first crop after vines, as compared
h stubble, we have a total credit for the vines when
d as fertilizer of $11.53 per acre in comparison with
value of the cowpea and velvet bean hay when uti-
d as stock food. The average yield of cowpea hay
m the stubble plots was 3,278 pounds per acre, and
velvet bean hay 4,781 pounds, or a collective average
4,030 pounds of legume hay per acre. At $10 per
, this would be worth $20.15 per acre. Subtracting
m this, $9.50 as above, we have $8.47 as the dif-
ence in the *first year's profits* in favor of utilizing the
es as hay. However, other factors must be consider-
before we have satisfactorily determined whether
vas most profitable to use the vines after picking the
s or to utilize the tops of both cowpeas and velvet
ns for hay; chief among these factors are the rela-
residual fertilizing values of vines and stubble as
wn by differences in the yield of the second and
sequent crops after legumes.

IAT IS THE FERTILIZING EFFECT OF VINES AND STUBBLE OF COWPEAS ON THE SECOND CROP AFTER THE LEGUME?

'he answer is found in the following table:

	Average increase in second crop after legumes.					
	After vines.			After stubble.		
	No. of tests.	Amt. increase.	% increase.	No. of tests.	Amt. increase.	% Increase.
corn	5	3.36 bus.	24	5	1.34 bus.	12
oats	1	7.75 bus.	54			
sorghum	4	2.15 tons	41			

n the second crop after the legumes there was in
ry case a considerable increase attributable to the
of the vines as fertilizer.

The fertilizing effect of the stubble as shown by th
second crop of corn is much less than the incremen
due to the vines plowed under many months before.

There is a sixth test with corn not belonging in th
preceding table, that gives additional data for a com
parison of the second-year effects of vines with stubbl
Combining the results of the six tests, we find that th
corn grown as the second crop after legumes afford
a larger yield on the vine plots than on the stubble plo
to the average extent of 2.1 bushels per acre, or 14 p
cent.

THE DURATION OF THE FERTILIZING EFFECTS OF STU
BLE AND VINES OF COWPEAS AND VELVET BEANS.

The stubble of these legumes repeatedly exerted
slight an effect on corn grown as the second crop, (a
average of only one and one-third bushels per acre
that we may reasonably conclude that two crops ma
the limit to which the benefits of legume stubble e
tends in cases where the soil is sandy and permeab
as at Auburn. It is quite possible that the advantag
from using stubble as fertilizer might have been slight
more enduring in a stiffer soil, but in no case can su
a relatively small amount of vegetable matter and nit
gen afforded by the roots and stubble influence the su
ceeding crops more than a few years.

It is quite a different matter when the vines, rep
senting the entire growth of the legume (except in so
cases the pods) are plowed under. We have learn
from the data in previous tables that the yield whe
the vines were used as fertilizer was in the first cr
63 to 189 per cent. greater than the yield of the corr
sponding crop immediately preceded by a non-legu
enous plant; and that in the second crop the increa

ged from 24 to 54 per cent. The effect exerted by the s of the legumes on the third succeeding crop was ed in only one field, the increase in oats as the third after cowpea vines being 3.2 bushels per acre, or per cent. With sorghum planted in 1901 as the th crop immediately after the oats were cut, there a perceptible increase on the plots where the vines owpeas and velvet beans grown in 1898 had been red under; extremely unfavorable conditions and ial failure of late sorghum detract from the reliay of the percentage figures for this, the fourth crop. three years or four crops the large mass of vines inued to exert some influence. This experiment was lucted on a soil of the stiffest type found on the on farm, which, however, is fairly permeable to er, and which might be described as a reddish loam aining an abundance of large flint stones.

e should expect an equal mass of leguminous vegeon employed as fertilizer on clay or prairie soils to cise a favorable influence for at least three years, robably for as long a period as do heavy applicas of coarse stable manure. Local experiments to rmine the permanency of the action of the legumes greatly needed, and correspondence is invited from ies wishing to make such tests.

is our expectation to continue work along the lines cated in this bulletin, and it is highly desirable that e investigations should be extended to include soils character different from that at Auburn, though means of doing this in a thoroughly satisfactory ner are not now in sight.

conclusion the writer would reaffirm his previous ement, made in Bulletin No. 107 of this station, as ows:

A Rational System of Fertilization.

Considering permanency of effect, as well as influ
on the crop immediately following, the cowpea and o
leguminous plants must be ranked as a cheaper so
of nitrogen than is any nitrogenous material which
be bought as commercial fertilizers. The aim of the
ton farmer should be to grow such areas of legume
will enable him to dispense with the purchase of n
genous fertilizers for cotton, using the funds thus s
to purchase increased amounts of phosphates or o
necessary non-nitrogenous fertilizers. The money
would have been necessary to purchase one pound o
trogen will buy about three pounds of phosphoric
or of potash, which larger purchases of phosphate
potash will enable the farmer to grow heavier crop
legumes. And heavier crops of legumes trap la
amounts of otherwise unavailable atmospheric n
gen and result in further soil enrichment.

In the writer's opinion *the most promising metho
increasing the yield of cotton per acre and the profi
cotton culture is by a more general use of legumi
plants as fertilizers.* These invaluable allies are
some farmers utilized and appreciated, but their
might be increased twentyfold with advantage to
current crop, to the permanent upbuilding of the
and to the filling of the farmer's pocket. It is put
the case very mildly to say that the average yiel
cotton per acre in Alabama might be increased b
least fifty per cent. through the general use of legu
as fertilizers.

APPENDIX. Condensed statement of effects of using cowpea and velvet bean vines or stubble as fertilizers at Auburn.

Legumes.	Vines or stubble.	Test crop.			Amt. per acre, increase.		Per cent increase.		Superiority of vines over stubble		Yield of legumes per acre.		Field.
		Plant.	1st or 2nd after legumes	Year grown	From vines.	From stubble.	From vines.	From stubble.	Am't per acre.	Per cent.	Lbs. hay.	Bus. cow-peas.	
Cowpea	V. & S.	Corn	1st	'01	......	......	......	......	8.88	78	1648	......	D
Cowpea	V. & S.	Corn	1st	'01	......	......	......	......	.60	2	3920	......	M
Cowpea	V.	Cotton	1st	'99	367	......	32	......	......	......	......	11.8	D
Cowpea	V.	Oats	2nd	'00	5 8*	......	29*	......	......	......	......	......	D
Cowpea	V.	Oats	2nd	'00	9.7	......	79	......	......	......	......	......	D
Cowpea	V.	Sorghum	1st	'97	1.6	......	86	......	......	......	......	......	F
Velvet bean	V.	Sorghum	1st	'97	1.6	......	85	......	......	......	......	......	F
Velvet bean	V.	Corn	1st	'01	12 3	......	81	......	5.0	28	......	......	D
Velvet bean	S.	Corn	1st	'01	......	4.3	......	32	......	......	3632	......	D
Velvet bean	V. & S.	Corn	1st	'00	......	......	......	......	11 9	76	2800	......	D
Velvet bean	V. & S.	Corn	2nd	'01	......	......	......	......	3.9	33	......	......	D
Cowpea	V.	Sorghum.	1st	'99	2.1	......	57	......	0.1	1	......	13.6	T
Cowpea	S.	Sorghum.	1st	'99	......	2 0	......	55	......	......	6400	......	T
Velvet bean	V.	Sorghum.	1st	'99	3.1	......	86	......	......	......	......	......	T
Velvet bean	S.	Sorghum	1st	'99	......	2.2	......	59	......	......	5360	......	T
Cowpea	V.	Corn	2nd	'00	3.6	......	15	......	2.0	8	......	......	T
Cowpea	S.	Corn	2nd	'00	......	1 6	......	6	......	......	......	......	T
Velvet bean	V.	Corn	2nd	'00	2.6	......	11	......	2 4	10	......	......	T
Velvet bean	S,	Corn	2nd	'00	......	.2	......	1	......	......		......	T
Velvet bean	V.	Cotton	1st	'99	546	......	64	......	......	......	......	......	T
Cowpea	V.	Cotton	1st	'99	696	......	83	......	......	......	......	......	T
Velvet bean	V.	Sorghum	2nd	'00	3.1	......	61	......	......	......	......	......	T

Velvet bean	V.	Oats	1st	'98	20.2	....	240	....	......	......	......	......	F.
Velvet bean	S.	Oats	1st	'98	....	30.3	....	360	¶7 6	¶27	3872	......	F.
Cowpea	V.	Oats	1st	'98	20 4	....	242	....	......	......	......	11.	F.
Cowpea	S.	Oats	1st	'98	....	26 0	....	309	¶10.1	¶35	2420	......	F.
Velvet bean	V.	Corn, late	2nd	'98	2 1	....	36	....	0 7	9	......	......	F.
Velvet bean	S.	Corn. late	2nd	'98	....	1 9	....	33	......	......	......	......	F.
Cowpea	V.	Corn. late	2nd	'98	0 9	....	16	....	......	......	......	......	F.
Cowpea	V.	Corn, late	2nd	'98	....	0.4	....	7	¶1.0	¶6	......	......	F.
Velvet bean	V.	Wheat	1st	'00	5.4	....	174	....	......	......	......	......	F.
Velvet bean	S.	Wheat	1st	'00	....	4.7	....	151	......		......	......	F.
Cowpea	S.	Wheat	1st	'98	5.9	....	190	....	......	......	......	7 9	F.
Cowpea	V.	Wheat	1st	'00	....	8.7	....	280	¶2 8	¶31	2004	......	F.
Sp. Peanuts	††	Rye	1st	'00	4280	....	181	....	......	......	......	......	F.
do. nuts remv'd	....	Rye	1st	'00	1080	....	41	....	......	......	......	......	F.
Run'g Peanuts	All.	Rye	1st	'00	2852	....	121	....	......	......	......	......	F.
Cowpea	V.	Rye	1st	'00	2600	....	110	....	......	......	......	......	F.
Velvet bean	V.	Rye	1st	'00	2360	....	100	....	......	......	......	......	F.
Velvet bean	All.	Rye	1st	'00	3360	....	142	....	......	......	......	......	F.
Sp. Peanuts	V.	Sorghum	2nd	'01	Loss.	....	Loss.	....	......	......	......	......	F.
Run'g Peanuts	All.	Sorghum	2nd	'01	960	....	16	....	......	......	......	......	F.
Cowpeas	V.	Sorghum	2nd	'01	400	....	7	....	......	......	......	......	F.
Vel. beans (av.)	V.	Sorghum	2nd	'01	1995	....	---37	....	......	......	......	......	F.

* Nitrate of soda used both on non-legume and legume plot.
** Reducing the increase to that on corresponding cowpea plot.
¶ Stubble afforded the larger yield.
†† Peanuts eaten by hogs on land where grown.

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HERD RECORD AND CREAMERY NOTES

BY R. W. CLARK.

ultural Experiment Station

OF THE

ricultural and Mechanical College,

AUBURN.

IERD RECORD AND CREAMERY NOTES.

. W. CLARK.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

HERD RECORD AND CREAMERY NOTES

BY R. W. CLARK.

———

ying be made profitable in Alabama is a
en asked.

ld winters, long pasture seasons, and a great
oiling crops, along with the output of the oil
ills, afford a large field from which to select
The State is badly in need of such profits
om dairying and live stock growing in gen-
appearance of our rural communities. the
d condition of our soils, the tremendous
the commercial fertilizer trade, and the vast
noney (the proceeds of our only money crop,
t every year for hays, grains, meat and dairy
e convincing arguments against the exclu-
g of corn and cotton and a strong one in
ersified farming.

builds up the soil. From 75 to 90 per cent.
izing constituents of the food consumed is
the manure. Dairying makes the farmer
by giving him, daily, a salable product.
med one day is turned into cash the next,
f the risk incident to making a crop of corn
s avoided. No line of farming in the South
n of returns as dairying when intelligently
The long growing season makes the dairyman
endent of drought, a great menace at times
ctions, especially where the summers are
climate is most salubrious. Many of the
ses common in other sections, caused by close

housing are almost unknown. Cattle can be turned every day so far as temperature is concerned, but t should be housed at night during the winter.

The demand in the South for good dairy produc always strong and especially so at the present time it is likely to continue so for many years. Cheese s for 12 to 20 cents per pound, butter 20 to 35 cents pound, and whole milk for 20 to 40 cents per gallon retail.

In calculating the cost of food for each animal in station herd the value of home-grown stuff was e mated. Bought stuff is figured at its market price.

	Price per ton for the year 1900-01.	Price per for the 1901-
Hay	$10 00	$1
Ensilage	2 00	
Oat straw	5 00	
Cotton seed hulls	4 00	
Soiling crops (fed green)	2 00	
Wheat bran	20 00	2
Cotton seed	9 00	1
Cotton seed meal	20 00	2
Rice polish	.....	2
Skim milk	25c per cwt.	30c per

The value placed on oat straw in the above tabl too low. Pasturage is estimated at fifty cents per mo for cows and grown animals and thirty cents per mo for young animals.

owing record shows what the station herd did years ending September 1, 1902:

PTEMBER 1, 1900, TO SEPTEMBER 1, 1901.

Breed.	Age at beginning of milking year. Yr Mo	Average weight—Pounds.	Milk—Pounds.	Butter—Pounds.	Cost of keep, including pasture.	Cost of butter per pound. Cents	Cost of milk per gallon. Cents	Profit on butter at 25c. per pound.
ersey..	7	828	3,492.8	168.4	$24.29	14.4	5.7	$17.85
ersey..	10- 2	804	3,740.4	205.4	21.09	10.2	4.6	30.39
ersey..	6	810	4,665.7	232.7	24.90	10.7	4.4	33.27
ersey..	2	649	3,095.6	216.5	20.69	9.5	5.3	33.55
ersey..	2- 6	614	5,065.8	331.7	24.28	7.3	3.8	58.71
olstein	9- 4	1003	4,676.3	215.3	28.15	13.0	4.9	25.83
ersey..	5- 1	767	4,218.6	246.0	23.56	9.5	4.6	38.13
....	.....	782	4,136.4	230.8	$23.85	10.6	4.7	......

per cent. of fat, 4.7.

PTEMBER 1, 1901, TO SEPTEMBER 1, 1902.

Breed.	Age at beginning of milking year. Yr Mo	Average weight—Pounds.	Milk—Pounds.	Butter—Pounds.	Cost of keep, including pasture.	Cost of butter per pound. Cents	Cost of milk per gallon. Cents	Profit on butter at 25c. per pound.
ersey..	7-10	805	4,581.3	234.7	$30.97	13.2	5.5	$27.69
ersey..	11	880	4,806.6	264.8	30.21	11.4	5.1	35.99
ersey..	7- 1	847	3,519.9	193.5	22.74	11.7	5.3	25.73
ersey..	3	786	2,271.2	159.1	15.43	9.6	5.5	24.50
ersey..	3- 8	676	4,316.0	297.9	26.31	8.8	4.9	48.25
ersey..	6	814	4,290.9	225.0	24.93	11.0	4.7	31.50
ersey..	2	662	3.321.5	217.7	22.49	10.3	5.5	32.00
ersey..	3- 2	692	4,586.5	286.0	24.75	8.6	4.9	47.01
Red Poll	2-11	1131	2,262.2	113.1	20.90	18.4	7.5	7.46
....	....	810.3	3,772.9	221.3	$24.30	11.4	5.4	......

per cent. of fat, 5.00.

ater profit for the year 1900 and 1901 is due rices of foodstuffs, more copious feeding of uring the winter and a better summer pasture. nt of grain in the ration usually depended character of the grain, the character of the the condition of the animals. All things be-ne, a well developed cow several months along n received less grain per 1000 pounds live

weight than a cow not so well developed and not so f
along in lactation. With cow pea hay and ensilage t
grain part of the ration rarely exceeded 6 and 7 lbs. p
day, and often dropped to 2 and 3 lbs. per day. Ind
criminate feeding of grain and poor cows are usua
the cause of losses and of small profits to the dairyma
Liberal, judicious feeding and kind treatment go ha
in hand.

Ada, although possessing good dairy type, carr
considerable flesh, and during the year 1900 and 19
gave a small profit, it being an off year with h
Clementina is the poorest cow. She is of the b
type and is well covered with heavy flesh. The fo
cost of Houron for the year 1901 and 1902 is light. S
milked heavily when fresh, but began to dry off ea
and then cow pea hay was partially substituted for gra
Her cost of keep ($15.43) for the year 1901 and 1902
low because she calved in the summer, did her best
grass and was far along in lactation by winter. Tl
allowed light feeding of grain during the winter (2 ll
per day), cow pea hay, sorgum hay and oat straw for
ing the greater part of her ration. The advisability
so light a grain ration is questioned. A long pastu
season means cheap production.

Young cattle are usually turned to pasture the lat
part of March and are not taken up until about t
middle of December. Cows are turned to pasture t
middle of April, and then receive grain only while
milk. They are soiled in late fall but depend more
less on pasture until the first of December.

On the whole the yearly productions are smaller th
they ought to be. A cow should give from 5000 to 70
lbs. of milk per year and make not less than 300 lbs.
butter.

COST OF RAISING HEIFER CALVES.

Hazena, a registered Jersey was dropped October 22, 1899, and weighed 56 lbs. The first year she consumed 159 lbs. whole milk, 2738 lbs. of skim milk, 66 lbs. bran, 224 lbs. of hay and was on pasture 161 days. When one year old she had cost $12.86 and weighed 435 pounds. The second year she received sorghum hay, ensilage, oat straw, cornstover and a little cotton seed and bran, and was on pasture 224 days. The cost of keep the second year was $9.09 and she weighed 665 lbs. She dropped her first calf when lacking seven days of being two years old. Total cost of keep up to the time of calving was $21.95.

Ella, a registered Jersey, was dropped August 12, 1900, and weighed 50 lbs. The first year she consumed 259.5 pounds of whole milk, 1195 pounds skim milk, 180 pounds bran, 63 pounds of corn meal, 405 pounds hay and was on pasture 112 days. She cost, including pasture, during her first year, $11.65, and weighed when 12 months old 340 pounds.

The second year, aside from pasture, she received cotton seed, cornstover, oat straw and ensilage. She dropped her first calf when 22 months old. The cost of keep the second year up to time of calving was $7.61, making a total cost of $19.26.

Peggy, another Jersey, was dropped July 23, 1900, and weighed 36 pounds. The first year she consumed 287.5 pounds whole milk, 1097 pounds skim milk, 191.6 pounds bran, 67.8 pounds corn meal, 399 pounds hay and was on pasture 91 days. She cost $11.49 and weighed 350 pounds when one year old. The second year she received the same kind of feed as Ella. She dropped her first calf when just two year old. The cost

of keep the second year was $7.99, and the total cost of keep was $19.48.

Jenny, a registered Jersey, was dropped November 24, 1900, and weighed 38 pounds. The first year she consumed 52 pounds whole milk, 1740 pounds skim milk, 45.5 pounds bran, 176 pounds hay and was on pasture 217 days. She cost $9.60 and weighed 295 pounds at one year old.

The second year she received the same kind of food as Ella and Peggy. By reason of an accidental service she dropped her first calf June 24, 1902, at nineteen months of age, and then weighed 445 pounds. The cost of keep for the second year was $7.61, and the total cost of keep for nineteen months was $17.21.

Alamarzena, another registered Jersey, was dropped April 16, 1901, and weighed 50 pounds. She received the same kind of food as the others mentioned above. When one year old she weighed 350 pounds and cost $13.66.

Mabel, Hazena's first calf, was dropped October 15, 1901, and weighed 43 pounds. She consumed 92 pounds whole milk, 1191.2 pounds skim milk, 322.7 pounds hay, 204.2 pounds bran, and was on pasture 165 days. The total cost of keep at one year old was $11.40.

Summary of Cost of Raising Heifer Calves.

NAME.	Cos of keep the first year.	Cost keep the second year.	Total cost of keep to time of calving.
Hazena	$12 86	$9 09	$21 95
Jenny	9 60	7 61	17 21
Peggy	11 49	7 99	19 48
Ella	11 65	7 61	19 26
Alamarzena	13 66	....	....
Mable	11 40	....	....
Average	$11 77	$8 07	$19 47

, Peggy and Jenny are undersize and would not been bred so early as they were had not a neigh- bull, in an enjoining pasture, broken into the Sta- erd. They are very small, due mainly to early ng and to a small consumption of skim milk when young calves.

re can be no set age at which young dairy heifers l be bred. If they are well developed, strong and they should drop their first calf when 24 to 30 s old.

fers should be kept growing from the time they rn until they reach maturity. A shortage of a few s worth of feed on the calf will mean a loss of dollars at the pail when the calf becomes a cow. terial advancement is to be made in animal breed- e pregnant mother must be well fed. The fœtus l be well nourished from the time the dam con- until it is dropped and has reached the goal to it is destined.

REMOVING BITTER WEED TASTE FROM CREAM.

ing the last three years considerable effort has made to find a means by which the odor and taste d onion and bitter weed may be removed from milk ream. In the spring of 1901 the writer was re- d to try a patent compound claimed to remove all of weedy taste from milk. It was fed to the Sta- erd according to the directions of the manufacturer ur weeks, in which time it proved to be an absolute e. Cooking soda (saleratus) was also given a like but failed of the purpose claimed for it by some e. Having failed so far to find anything that when

fed to the cows would remove weedy taste in the m
the next step was treating the milk and cream.

The following are creamery notes taken in the carry
out of this work:

Treatment of cream before running through the separator.	*Notes on treated cream coming from the separator; untreated cream being very*
One gallon of cream was thoroughly mixed with 2 gallons of water, at a temperature of 150° F., in which one ounce of saltpeter had been thoroughly dissolved.	Bitterness removed, but f of cream not good, rather so
Same as above, but no saltpeter used.	Not a trace of bitterness i washed cream.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F.	Not a trace of bitterness i cream, and of a fine flavor.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F., and containing 1 oz. of saltpeter.	Bitterness removed, but c not very good.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F.	Bitterness removed.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 74° F.	Bitterness removed.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 74° F.	Excellent cream, not a tra bitterness.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 68° F.	A slight trace of bitterne the cream, but this would not narily be detected.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 69° F.	Slight trace of bitterness f cream.

ed taste was removed entirely from cream by mixing it with two or more parts of water at rature above 70 deg. Fahrenheit, and then whole through the separator.

dissolved in water was tried as an aid g the bitterness, but as good results were hout it as with it.

and slowly heating milk and cream to various eratures did not remove bitterness but often cooked taste.

ade from washed cream (as above) was pro- ee of all bitterness by the Station customers. le from unwashed cream was decidedly bad en rejected by the customers. No means were move the bitter weed taste from whole milk ring of 1902 milk and cream were treated for nion flavor the same as in the previous year er weed taste.

The following are the creamery notes taken i
course of this work:

Treatment of cream before running it through the separator.	*Notes on the treated after coming from the se*
One gallon of cream was thoroughly mixed with three gallons of water at a temperature of 90° F.	Flavor not removed; cre bad.
One gallon of cream was mixed with two gallons of water, at a temperature of 90° F., in which was dissolved one ounce of saltpeter.	Flavor bad, and made r by the use of saltpeter.
Same as preceding treatment.	Flavor still bad.
Same as preceding treatment, except temperature of water 100° F.	Flavor still bad.
Same as preceding treatment.	Flavor bad.
One gallon of cream was mixed with two gallons of water at a temperature of 212° F., in which was dissolved one ounce of saltpeter.	Flavor still bad.
Same as preceding treatment.	Flavor very bad, and from this cream was reje the station customers.
Same as preceding treatment.	Same result as above.
One gallon of cream was mixed with two gallons of water, at a temperature of 95° F.	Cream bad.

and taste of wild onion was not removed from
d cream by any method of treatment employ-
was washed as above with and without salt-
at different temperatures, but the onion taste
we:e not removed. Butter made from the
am was rejected by the Station customers.
d slowly heating milk and cream to various
eratures did not remove the objectionable
nparted by the onion.

as thoroughly mixed with ether and carbon
and these were then evaporated. The onion
partly removed in both cases, but the cream
ough of the ether and carbon bisulphide to
nfit for use.

pound in the bitter weed which gives milk a
is held very largely, if not entirely, in the
n. The more completely the serum is separ-
he fat the less is the degree of bitterness in
. The compound in the wild onion which
a bad flavor is held very largely, if not en-
he fat, and the more completely the serum is
from the fat the more concentrated is the
r in the cream.

cream makes it thick and necessitates adding
le skim milk, which may be a starter, to bring
per consistency before churning. If a large
starter is used to thin with, a shorter length
required for ripening, therefore the cream
atched closely until the proper degree of ripe-
hed.

n starter as used above means sour milk that
our the cream.

ontaining bad flavors but not sour enough to
ed, can often be improved by washing. The
cream the less likely is it to sour and clabber.

DIFFERENT SYSTEMS OF CREAMING.

The question is often asked, does it pay to run a cre separator for a small amount of milk.

The following table gives the average per cent. of left in the skim milk by the different systems of cre ing, but at different temperatures. As the use of on the average farm in Alabama, is generally out of question, it was not used, but conditions were taken they exist on the average farm, and the results secu are believed to be fairly representative of practical c ditions. This work was done in August when weather was hot, except that one of the deep setting t was made in April.

SEPARATOR VERSUS DEEP SETTING VERSUS SHALLOW PA

System.	Temperature, Degrees F.	Per cent. of fa skim milk		
		Average.	Min.	M
Separator	81.0	.03	.01	
Deep setting	50.0	.54	.30	
Deep setting	83.6	1.30	.80	
Shallow pans	85.7	.60	.35	

There is a heavy loss in creaming milk by the gra system. During hot weather the loss may be one-fou to one-third of the total butter fat. Shallow pans better results than deep cans. With the separator loss of fat in the skim milk was very slight, ha worth considering. Where facilities for handling cre and butter can be had, and where the skim milk is p tically wasted, it will pay, according to the data in above table, to have a separator for even as small a n ber as two good cows. These two cows together ou to produce 12,000 pounds of milk per year. One-eig of the whole milk being cream, there will be 10,

ds of skim milk. As the separator leaves only .03
e per cent. of fat in the skim milk, there will be a
during the year of 3.1 pounds of butter fat, the
alent of 3.6 pounds of butter. With deep set-
at a temperature of 83.6 degrees Fahrenheit (a
approximation to our summer temperature), there
be a loss of 159 pounds of butter in the skim milk,
een one-third and one-fourth of the total. With
ow pan setting at a temperature of 85.7 degrees
enheit, the loss will be 73.5 pounds of butter in the
milk. Along with the saving of butter fat a sepa-
gives better cream, a better butter and better skim
The cream separator is indispensable to the
man of the Gulf States of the South.

EFFECT OF FOOD ON THE MELTING POINT AND VOL-
ATILE ACIDS OF BUTTER.

the year 1901 feeding experiments were carried on
certain the effect of different amounts of cotton seed,
n seed meal and cotton seed hulls, in combination
bran and sorghum hay, on the composition of but-
nd for this purpose six cows were divided into two
of three each. They were fed in the barn all that
would eat up clean twice a day, and were confined
alls during the night. One week of preparatory
ng preceded the experiment proper, which lasted
our weeks.

FOOD AND AVERAGE COMPOSITION OF BUTTER FROM E KIND OF FOOD.

Group.	Ration.	Melting point of butter degrees centigrade.	C. C. of alkali required to neutralize the volatile
I	9 pounds cotton seed 3 pounds bran 10 pounds sorgum hay	41.1	
II	5¼ pounds cotton seed meal 3 pounds bran 10 pounds cotton seed hulls	40.7	

There is practically no difference in the melting p and volatile acids of the butter made from the al rations.

Analysis of a sample of Northern butter, made at same time, in which no cotton seed products were gave a melting point of 24.5 degrees (centigrade), required 13.5 c. c. of alkali to neutralize the vol acids in 2.5 grams of fat.

During April and May nine cows were divided four lots of two cows each and one lot of one cow. T were fed grain night and morning and confined to barn only while eating their grain and being mil Pasture was the only forage received and conseque all received of it alike. The feeding period proper la three weeks.

AVERAGE COMPOSITION OF BUTTER FROM EACH KIND OF FOOD.

Ration.	Melting point of butter degrees centigrade.	C. C. of alkali required to neutralize the volatile acid in 2.5 grams of fat.
3 pounds cotton seed 1 pound bran	41.76	10.6
3 pounds co..on seed meal 1 pound bran	41.92	9.6
5 pounds cotton seed meal 1 pound bran	39.6	10.37
8 pounds cotton seed meal 1 pound bran	40.84	10.1
4 pounds bran	38.6	9.65

cotton seed and cotton seed meal to cows on ad a slight effect in hardening the butter, in- he melting point from 1 to 3 degrees centi- hree pounds of cotton seed meal and one bran gave as hard a butter as eight pounds of d meal and one pound of bran.

atile acids in the butter were not materially y the different rations.

MILK PRESERVATIVES.

y of milk preservatives for composite testing, in order to ascertain the one best suited to ions. Potassium bichromate, mercuric chloride lin were used. Each cow's milk was sampled drawn, and the sample taken was put into a

glass jar. At the end of the week these composite
ples of milk were tested for butter fat and notes ta
which are herewith presented.

Potassium bichromate, grains used for one pint of milk.	Mercuric chloride, grains used for one pint of milk.	Formalin.	Season.	Remarks.
3.08	....	....	Winter...	Test very good.
3.82	....	....	Winter...	Test fairly goo
4.62	....	....	Winter...	Test fairly goo
5.35	....	....	Winter...	Test fairly good
....	3.85	....	Winter...	Test very poor.
....	4.62	....	Winter...	Test not satisf
....	6.16	....	Winter...	Test not satisf
....	7.7	....	Winter...	Test not satisf
3.08	....	....	Summer..	Test not satisf
3.82	....	....	Summer..	Test not satisf
4.62	....	....	Summer..	Test not satisf
5.35	....	....	Summer..	Test not satisf
....	3.85	....	Summer..	Test not satisf
....	4.62	....	Summer..	Test not satisf
....	6.16	....	Summer..	Test not satisf
....	7.7	....	Summer..	Test not satisf
....	....	½%mixture	Summer..	Very satisfactor clear, no sedin below fat line

Three to four grains of potassium bichromate in a
of milk served fairly well as a preservative, this
rial being best in the winter but requiring too freq
duplication of test in the summer when the weath
hot. It causes a more or less leathery condition o
cream which is difficult to re-emulsify, and in
weather the milk often undergoes a fermentation w
causes a loss of butter fat. The milk should not be
one week old before being tested.

Mercuric chloride proved unsatisfactory in n

y test with composite samples. The tests were very
7.

ne-half per cent. formalin (40 per cent. formalde-
e) proved the most satisfactory of the three preserva-
s tried and is now being used entirely at the Station.
f a teaspoonful of formalin to one pint of milk
es a one-half per cent. mixture.

otassium bichromate, mercuric chloride and forma-
are poisonous when taken internally and should be
dled with care.

ne-half teaspoonful of formalin will keep a pint of
in good condition for testing for one month in any
son.

CHURNING EXPERIMENTS.

uring the winter of 1900 and 1901 experiments were
ied on to ascertain the degree to which cream should
n before being churned. It has usually been assumed
t a fairly high per cent. of acid and a high tempera-
e are necessary in churning the cream of milk from
s receiving cotton seed or cotton seed meal.

lerate acidity and high temperature compared with low acidity and low temperature.

No. of trials.	Pounds of cream churned.	Per cent. fat in cream.	Per cent. acid in cream.	Temperture of churning.	Minutes churning.	Per cent. fat in Buttermilk.	Melting point of butter. Degrees centigrade.
	18	33	.37	70	16.7	.56	37.4
	18	33	.25	63	33.4	.19	39.6

In the 14 trials with an acidity of .37 per cent. an
temperature of 70 degrees Farenheit, the minimum a
maximum per cent. of fat in the buttermilk was .1 a
2.5 per cent. respectively. In the ten trials with an ac
ity of .25 per cent. and a temperature of 63 deg. Fahr
heit, the minimum and maximum per cent. of fat in b
termilk was .05 and .5 per cent. respectively. The m
exhaustive churning was made in 40 minutes at a te
perature of 67 deg. Fahrenheit, with an acidity of .49
cent. A ten gallon churn was used in this work.
of the cream was from cows receiving a heavy ration
uncooked cotton seed. The tests were made during
time when cows were on dry food.

In connection with this work notes were taken on
churnability of cream containing high and low perce
ages of fat. Cream containing 50 per cent. fat or m
stuck to the sides of the churn and usually had to
thinned with water before the churning was comple
The best churnings were made with cream contain
33 per cent. fat. Cream containing less than 25 or
per cent. fat did not churn well, it being too thin.
cream containing 50 or 60 per cent. fat had better ke
ing qualities than the cream containing 25 or 30
cent. fat, because a large per cent. of the bacteria t
cause trouble in the latter was eliminated in the sl
milk. In ripening thick cream a large quantity c
weak starter should be used. This will give good c
sistency to the cream and consequently a better churn
will be secured.

Churning whole milk with dash and barrel churn
As nearly all of the butter made in Alabama is m
from whole milk by the use of the dash churn a
trials of comparing the dash churn with the ba
churn were considered expedient.

DASH CHURN VS. BARREL CHURN.

12-GALLON BARREL CHURN.

...ned.	Temp. of milk when churned, Degrees Fah.	Minutes churning.	Per cent. of fat in Buttermilk.
	66	55	.55
	85	23	.42
	85	13	1.
	70	60	1.
	75	16	.5
	76.2	33.4	.69

3-GALLON DASH CHURN.

	75	16	.5
	80	15	.5
	85	15	1.
	85	40	.4
	66	10 1	.55
	78.2	37.4	.59

...ng to the above reported trials, with their ...ations, the dash churn gives practically the ...lts as the barrel churn, and vise versa. In ...eported above the milk, when churned, was in ...lition, and was well clabbered.

...e barrel churn the buttermilk can be drawn ...he bottom, and the butter washed better and ...y than with the dash churn. This is the only ... that the author can see of the barrel churn ...lash churn for churning whole milk.

...thod of churning whole milk is practicable ...able in the South during the summer months ... weather is hot and ice can not be had, and ...of the buttermilk is consumed by the family. ...od butter for local and immediate consump- ...e made if the milk is cooled as much as pos- ...n drawn, and sour milk (starter) of good ...ded immediately. When the temperature can ...ntrolled to any extent the ripening (souring) ...gin at once.

Modern dairy methods must be adopted by the Sou
if it receives the full benefit of its natural dairy a
vantages.

SUMMARY.

1. The average yearly production per cow in t
Station herd, for the two years ending September
1902, was 3954.6 pounds of milk and 225 pounds of bu
ter. The average yearly cost of keep per cow was $24.0
the average cost of butter per pound was 11 cents, a
the average cost of milk per gallon was 5.5 cents.

2. The average cost of raising a heifer calf the fi
year was $11.77, the second year $8.07 and the total co
to time of calving was $19.47.

3. Bitter weed taste was removed from cream
mixing it with two or more parts of water at any te
perature above 70 deg. Fahrenheit and then running
through a cream separator. No means were found
which bitter weed taste could be removed from milk. T
compound in the bitter weed which gives milk a bit
taste is held very largely, if not entirely, in the m
serum. The more completely the serum is separat
from the fat the less is the degree of bitterness in t
cream.

.4 Wild onion flavor was not removed from crea
by mixing it with water and then running it throu
the cream separator. Saltpeter dissolved in the water th
used was of no value. No method was found by whi
the onion flavor could be removed from either milk
cream. The compound in the wild onion which giv
milk a bad flavor is held very largely, if not entirely,
the fat, and the more completely the serum is separat

ıt the more concentrated is the onion flavor in

average percentages of fat left in the skim e separator, deep cans and shallow pans were l .6 respectively. Shallow pans gave decidedly ılts than deep cans. The separator is indis› the dairymen of the South.

ıtion consisting of 9 lbs. cotton seed. 3 lbs. ı and 10 lbs. sorghum hay gave a butter prac- al in firmness and volatile acids to a butter on consisting of 5½ lbs. cotton seed meal, 3 bran, and 10 lbs. of cotton seed hulls. Feed- seed and cotton seed meal to cows on pasture he melting point of the butter 1 to 3 degrees Three pounds of cotton seed meal and of wheat bran gave as hard a butter as eight cotton seed meal and one pound of bran. The ds in the butter were not materially affected ferent rations.

ssium bichromate, mercuric chloride and were tried as preservatives for composite One-half per cent. mixture of formalin (40 ormaldehyde) gave the best results. One-half l of formalin will keep a pint of milk in good for testing for one month.

hurning cream from cows receiving cotton otton seed meal .25 of 1 per cent. lactic acid in with a temperature of 63 deg. Fahrenheit, ore exhaustive churning than .37 of one per actic acid with a temperature of 70 degrees ;.

churning experiment of five trials, the dash ved as satisfactory as the barrel churn for vhole milk.

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ALABAMA.

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

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razing and Feeding Experiments with Pigs.

By J. F. DUGGAR.

BROWN PRINTING CO., PRINTERS & BINDERS
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1903.

GRAZING AND FEEDING EXPERIMENTS WITH PIGS.

By J. F. Duggar.

Summary.

Pigs made a more economical growth just after weaning than did sow and pigs just before weaning time.

The following plants were tested as hog food, the hogs doing the harvesting; these plants are available for use in the months indicated:

Spanish peanuts, August to December.
Chufas, November to March.
Cowpeas, July to November.
Sweet potatoes, August to November.
Sorghum, July to November.
Vetch and oats, March, April and May.

Dwarf Essex rape (spring sown), May and June.
Dwarf Essex rape (fall sown), December, January, February, March, and part of April.

In most cases it was necessary to feed, in addition to the above crops, from one-fourth to one-half of the usual ration of grain. If we assume that of this grain 5 pounds was required to produce one pound of increase in live weight, we have left the following amount of growth of shoats attributable to one acre of each crop after deducting the gains due to the grain consumed.

Peanuts (with grain) in 7 tests averaged 333 pounds of growth, now worth $16.65.

Peanuts alone in 2 tests averaged 281 pounds, worth $14.05.

Chufas in 2 tests averaged 307 pounds, worth $15.35.

Cowpeas in 2 tests averaged 229 pounds, worth $11.45.

Essex rape in 2 tests averaged 452 pounds, worth $22.50.

Sorghum in 2 tests averaged 174 pounds, worth $8.70.

One acre of the best of these crops (peanuts, rape, and chufas) afforded pasturage for one month for at least 25 100-pound shoats, when a half ration of grain was fed.

The average amounts of grain required to make one pound of growth on shoats, consuming also the crops below, were as follows:

1.77 pounds of grain with peanuts;
2.30 pounds of grain with chufas;
3.07 pounds of grain with cowpeas;
2.68 pounds of grain with rape;
3.70 pounds of grain with sorghum;
3.13 pounds of grain with sweet potatoes.

Pigs grazing on sorghum, fully headed out, ate only 12 per cent less grain per pound of growth than those supported entirely on corn.

Shoats fed on a mixture of corn meal and of 20 or 25 per cent cotton seed meal in most experiments ate but little food and made very slow growth. In other experiments they required only 3.84 and 4.68 pounds of this mixture per pound of growth.

The feeding of cotton seed meal as part of the grain ration for 34 to 38 days in most cases had a poisonous effect on shoats weighing from 59 to 118 pounds each. No ill effect was noticed prior to the thirty-third day and some pigs showed no perceptible ill effects on the thirty-second day.

on seed meal caused death or sickness of shoats
onstituting one-fifth or one-fourth of the grain
whether the cotton seed meal mixture was
ne or in connection with a bountiful supply of
orghum or peanuts.

ılated on a basis of 100 pounds live weight, daily
f .25, .40, .41 and .53 of a pound of cotton seed
r 34 to 38 days caused sickness or death; .61 of
d daily for 35 days fed in different years to
of practically the same size caused evident un-
n one experiment, while in the other no imme-
ffects were discernible. Shoats averaging 143
in weight were not hurt by eating for 31 days
pound of cotton seed meal daily per 100 pounds
ight. Evidently the younger the pig the more
ible they are to cotton seed meal poisoning.

ealth of shoats was injuriously affected or death
l, where, in an exclusive mixed grain ration, the
of cotton seed meal consumed per 100 pounds
weight reached, with the smallest shoats 9.2
and with larger shoats, 21.4 pounds; while in
experiment 21.5 pounds of cotton seed meal
nsumed per hundred weight without immediate
es of injury, and in a fourth experiment 22.6
per 100 pounds of live weight was consumed
visible effects on the health of large shoats.
a cotton seed meal mixture was fed in connec-
th grazed sorghum, cut sorghum, or grazed pea-
oxic effects were manifested when respectively
.9 and 17.7 pounds of cotton seed meal per hun-
eight had been consumed. We obtained highly
tory growth when some cotton seed meal was
short periods to shoats while grazing peanuts.

uts fed up to the date of slaughter made a very
d. Chufas softened the lard to an almost equal

The feeding of grain of any of the kinds tested to pigs whose flesh had previously been softened by feeding on peanuts greatly solidified the lard, but the exclusive feeding of grain for 26 to 35 days just before butchering failed to make the flesh and lard as firm as that of pigs which had never consumed peanuts.

When a mixture was fed containing 20 or 25 per cent of cotton seed meal and the remainder corn meal, the melting point of the lard was 3.4 degrees F. higher than when only corn meal was fed.

Rice bran was not relished by hogs and it did not afford rapid growth.

Rice polish in 5 experiments proved superior to corn meal. One pound of growth required only 3.73 pounds of rice polish as compared with 4.74 pounds of corn meal. Hence 78.6 pounds of polish were equal to 100 pounds of corn meal for shoats.

Corn hearts proved decidedly inferior to corn meal, and to cowpea meal.

Skim milk in moderate amount saved about half of the usual quantity of grain in the ration of shoats.

INTRODUCTORY.

Hogs are profitable property. Now that the prices of live hogs and of meat are unusually high this lesson is being brought home most forcefully. Hogs were profitable even when they sold on foot at 3 to 3½ cents a pound as they did locally when our earlier experiments, published in Bulletins Nos. 82 and 93 of this station, were under way.

Whatever the price of hogs or of pork it is necessary to the maximum profit that we make sparing use of corn in most portions of the Gulf States. We need to economize in the use of corn, not by stinting the total

it of food offered, but by making use of other crops can be grown on certain soils at less expense or are more effective foods. To ascertain the rela- ork-producing values of some of the special hog and their effect on the quality of flesh and lard en the principal aim of most of the experiments bulletin.

se experiments herein recorded extend over a of four years. During the first year of this the details of feeding and weighing were in the of Mr. T. U. Culver. During the last three years rt of the work has been done by Mr. R. W. Clark, ly Assistant Agriculturist of this Station. To f these acknowledgements are due for cordial co- ion and for faithful services.

results of seven years' experiments in growing l hog crops enable us to suggest a succession of of proven value to be harveted by hogs, to which hope to be able to add a number of others when ave been further tested, among them being al- artichokes, pumpkins and soy beans.

Succession of hay crops.

ths used.	Crops.
and ary...	Fall-sown rape and chufas.
, to 15....	Fall-sown rape, vetch and oats, rye, wheat, etc.
.. ..	Vetch and oats, crimson clover, oats and wheat
......	Spring-sown rape, vetch and oats, wheat and the usual pastures.
.....	Spring rape, stubble fields, turf oats and the usual pastures.
d t.....	Sorghum, early varieties of cowpeas, and the usual pastures.
er, r and nber..	Spanish peanuts, cowpeas, sweet potatoes and sorghum.
er ...	Chufas and fall-sown rape.

Among these special hog crops attention is here directed to Dwarf Essex rape, because it is so little known, so palatable, so nutritious and because it can be so effectively used at once to relieve, to some extent, the present scarcity of corn. For the successful growth of rape the land must be as rich and as highly fertilized as for turnips, and preparation, sowing and cultivation are the same as with that crop, except that rape is not thinned. Sow 3 to 5 pounds of seed per acre in narrow drills between September 20 and October 20. Seed are cheap, 10 to 12 cents per pound, and they are sold by all seedsmen. We have also sown rape in March, getting hog pasturage in May and June.

In the summary the present local price of hogs, 5 cents per pound, has been used in estimating the value of one acre of each crop when converted into pork. However, in the body of the bulletin use has been made of the local price prevailing at the time when each experiment was made.

We can estimate the increase in live weight due to one acre of some special crop only by calculating the probable approximate amount of growth due to the grain fed. The amount of grain required, when fed alone, to produce one pound of growth varies of course with many conditions, but the average of many experiments is not very far from five pounds.

In assuming this figure we have sacrificed strict accuracy to uniformity and clear presentation. Those who prefer to use a different factor will find it possible from the date in the body of this bulletin to calculate the net gains per acre of hog crop, whatever factor they select.

Growth of Pigs Before and After Weaning.

On farms where dairying is an important industry and [wh]ere there is an abundance of skim milk for sow and [lit]ter, it is not unusual for the brood sow to nurse a [lit]ter of pigs without herself losing weight. In the [ab]sence of skim milk we find that the sow generally [los]es in weight, however bountiful the supply of grain [an]d green material.

For example in the period between farrowing, Feb[ru]ary 24, 1899, and the beginning of the experiment [Ap]ril 1, a sow lost 29.6 pounds, and her litter of 7 [pi]gs gained 67.3 pounds. During this time sow and [pi]gs were kept in a bare lot and fed a mixture of equal [we]ights of ground cowpeas and a very coarse grade [of] rice meal, which in this case consisted largely of [gr]ound rice chaff. The amount of this mixture con[su]med in this time was 273 pounds.

This sow and her seven pigs were confined by means [of] hurdles or movable panels on a field where vetch [an]d turf oats grew together. At the end of a five weeks' [pe]riod, May 6, the sow was removed and the pigs, now [10] weeks old, were continued on the same character of [pa]sture three weeks longer, or until May 27. The herbage [wa]s more tender and succulent in the earlier periods, [th]ough its weight per acre was greater in the later pe[rio]d. The grain fed to the sow and pigs while they [gr]azed on vetch pasture was corn meal.

Gains made and food consumed before and aft
weaning.

	Before weaning.		After wea	
	5 weeks.	Per week.	3 weeks.	w
	Lbs.	*Lbs.*	*Lbs.*	
Growth made by 7 pigs..........	113.60	22.70	55.40	1
Loss in weight of sow............	19.40	3.88	....	..
Net gain in weight of sow & pigs.	94.20	18.82	....	..
Meal consumed by sow* & pigs ..	554 20	110.8	244.00*	8
Lbs. meal per lb. growth of pigs..	4.88	....	4.40	..
Lbs. meal per lb. *net* gain of sow and pigs......................	5.88	....	....	..
Area of pasture grazed; square ft.	(8550)	(1710)	(3858.)	(1
Total weight of sow and pigs at beginning of period............	350.30	....	....	..
Total weight of 7 pigs at the beginning of each period.........	118.60	....	322	..

*Only pigs during last 3 weeks.

A pound of growth was made with less meal, pounds after weaning; before weaning it requ 4.88 pounds of corn meal for each pound of growth, we deduct from the gains made by the pigs the crease in the weight of the sow, we find that it requ 5.88 pounds of meal to make one pound of growt sow and pigs. This is a very unsatisfactory rat growth and probably due, at least in part, to in cient shade.

Growth of vetch and oats after grazing—As st above, the pigs just after weaning were penned mixture of hairy vetch and turf oats, sown the ious October on poor upland soil. Both oats and v had been delayed in growth and otherwise injure the unprecedented cold of February, 1899. More the vetch had been injured by root-knot.

While penned on the vetch and oats the weaned

, as stated in a preceding table 4.4 pounds of
al to make one pound of growth, in addition
isturage.

nteresting to note that on the areas grazed over
April 21 the vetch made, after the pigs were
sufficient second growth to afford about two-
a normal crop of excellent hay, the average
second-growth hay on the plots grazed between
tes being 1,278 pounds per acre. The vetch
e credited with part of the growth made by the
th the hay produced as a second growth, and
improvement of the fertility of the land which
marked as measured by the growth of silage
nted in June of the same year.

)WARF ESSEX RAPE AS FOOD FOR SHOATS.

May 27 to June 23 ,1899, these same seven
ere maintained on drilled green rape and corn
)uring the first two weeks the rape was pulled
ied to the shoats, while during the latter period
was grazed. The four weeks of rape feeding
reated as one period.

even shoats averaged in weight at the begin-
this period 41 pounds each. The area of drilled
d was 4190 square feet; corn meal was fed each
raging 1.62 pounds per pig per day, or 317.6
for the seven pigs in twenty-eight days. The
in weight was 103 pounds. Hence to make
ıd of growth required 3.1 pounds of corn meal
square feet of rape pasture. This is at the
.078 pounds of growth for one acre of rape and
ınds of corn meal.

assume that for shoats of this size fed on corn
ne 5 pounds of this grain would have been re-

quired for each pound of growth, the acre of rap would be credited with producing alone 413 pounds o growth, worth, at 4 cents per pound, $16.52.

In addition, the rape which had been grazed made second growth which was ready for pasturing withi a month after the removal of the shoats, but which wa ruined by the Harlequin cabbage bugs, or "calico backs, before it could be utilized.

The soil in which this patch of rape grew would b classed as sandy bottom land of medium grade.

Let us turn aside here from the history of this litte of pigs, which we may call litter M, to describe som tests of rape made in 1900 and 1901.

Rape as Winter Pasturage for Pigs.

Dwarf Essex Rape sown in drills on sandy uplan October 13, 1900, was ready for pasturage January 1901, when four pigs from litter O, weaned three week before, were confined on it with hurdles which we moved about once a week. The first growth of rape a forded pasturage until March 28. The second growt on land previously grazed over, afforded pasturage fro March 28 to April 18.

Throughout the whole period that the pigs were o rape they received also about a half ration of cor meal.

Less rapid and more expensive gains were made i March, when the plants had become tough and read to seed, than during January and February. The mo rapid and economical growth was made during the bri period while the succulent second growth was being co sumed.

eight of 4 pigs January 6 ....130 lbs.
eight of 4 pigs March 28 ....311 lbs.
in in 81 days ....181 lbs.
rn meal consumed in 81 days ....524 lbs.
unds meal per pound growth .... 2.9 lbs.
ea of 1st growth rape grazed..........13,912 sq. ft.

This is at the rate of 570 pounds of growth in live ight afforded by one acre of first-growth rape asted by 1641 pounds of corn meal. If we assume that pounds of corn meal made one pound of growth we ve left 242 pounds of live weight, worth $9.68, to be edited to one acre of first-growth rape.

March 28, the rape having begun to blossom and havg become relatively unpalatable, the hurdles were aced about the rape grazed in January and part of bruary, on which the second growth was by this time good condition for pasturage, though small.

On this second growth the pigs remained three weeks, eantine consuming the crop on one-sixth acre and ting 168 pounds of corn meal.

The growth made during these three weeks was 82 unds, or one pound of growth for only 2.05 pounds meal, which figure indicates that the pigs must have rived about half their sustenance from the green crop.

One acre of second growth rape assisted by 1008 unds of corn meal resulted in a growth of 492 pounds. we again assume a normal requirement of five pounds grain for one of growth we have 290 pounds of inease in live weight, worth $11.60, as the value of an re of second crop rape when converted into pork.

It is fair to add together the gains made on an acre ch of first growth and of second growth, since part the area was grazed twice. This gives a growth of 2 pounds of pork then worth $20.48, as attributable

to an acre of rape grazed twice. This is on the assum
tion that it would require 5 pounds of an exclusi
grain ration to produce a pound of growth.

GRAZING SORGHUM, FIRST EXPERIMENT.

Let us now return to the history of litter M, whi
had grazed on rape until June 23, 1899.

This litter of seven shoats was grazed on sorghu
from June 24 to September 2, 1899, meantime receivi
daily a very small amount, about 1½ pounds per da
per shoat of a mixture of equal weights of cowpea me
and corn meal.

During this time the seven shoats made an aggrega
gain of 22.44 pounds and utilized 15,374 square feet
drilled and cultivated sorghum, and also grazed t
second growth on 8380 square feet, or about half
this same plot. The grain meantime consumed w
812 pounds by the lot of seven shoats, or 3.6 pounds
grain for each pound of increase in live weight.

This is equal to a gain of 635 pounds of live weig
per acre of sorghum, assisted by 2298 pounds of grai
Assuming that if the grain had been fed alone 5 poun
would have been required to produce one pound
growth, we have left 195 pounds of growth attributab
to one acre of first growth sorghum and to about ha
of the second growth on the same.

At 4 cents per pound 195 pounds of growth gives
return of $7.80 per acre of sorghum.

Doubtless the value of an acre of sorghum woul
have been considerably greater if the second growt
on the entire area, instead of on half of it, had bee
utilized. It was noticed that the shoats required p
week about twice as large an area of second growt
as of first growth sorghum.

During a small portion of the time covered by this periment sorghum was cut and carried to the pigs d when this was done a given area lasted much longer an when hogs were turned in to graze, in which case e waste of green food, bitten down and not consumed, is excessive.

Where labor is abundant and cheap or where the use a corn harvester is possible it is believed that it will y to cut and carry the sorghum to the pigs rather than graze it.

When shoats averaging about 80 pounds received only e and one-half pounds of grain a day per head and re required to make growth chiefly on sorghum, the te of gain was slow, being a little more than half a und per day.

The sorghum when grazed was at the stages of growth tween early bloom and complete maturity and most it was about five feet high. The yield was rather ht, the land being poor, sandy upland, moderately fer- ized. The sorghum used in all our grazing experi- ents has been drilled and cultivated.

HE VALUE OF SPANISH PEANUTS AS PASTURAGE FOR PIGS.

In Bulletin No. 93 of this Station the writer has re- rded the very satisfactory results of several experi- ents in grazing pigs on peanuts in 1897. The results low confirm the conclusions which we have heretofore pressed as to the great value of peanuts as food for gs.

Peanuts and corn meal.—A litter of pigs farrowed ptember 1, 1899, was penned on Spanish peanuts ovember 4, after weaning. There was only about two- irds of a stand of peanuts.

The total increase of live weight up to December 2 was 298 pounds, during which time 482 pounds of cor meal was consumed or 1.62 pounds of grain per poun of growth. The area grazed over was 34,944 squar feet, or nearly five-sixths of an acre.

This is equal to a gain of 371.4 pounds of live weigh from one acre of peanuts assisted by 601 pounds c corn meal. If we assume that it required 5 pounds c grain to produce one pound of growth and subtract th amount of pork we have left 251 pounds of increase i live weight attributable exclusively to a poor crop c peanuts on one acre. With pork worth 4 cents pe pound gross this gives a value of $10.04 to an acre c peanuts converted into pork.

Peanuts, corn meal and milk.—From September 3 to November 4, 1899, account was kept of the foo consumed by a sow and litter of 9 pigs farrowed Sep tember 2. The food consumed during these fiv weeks was as follows:

355 pounds corn meal at 1 cent................	$3.5
921 pounds skim milk at ¼ cent	2.3
Total	$5.8

In addition to the above food, Spanish peanuts fro one-fourth acre of land were also fed.

During this time the sow made a gain of 9 pound showing that on a sufficiently nutritious and palatab diet the weight of the nursing sow can be maintaine The pigs made a gain of 226.5 pounds. The total gai of sow and pigs was 235.5 pounds, making the cost c grain and skim milk for one pound of growth 2.5 cent

Assuming that one pound of growth of sow and pig requires 5 pounds of grain in a ration like this, an

as in certain Wisconsin experiments, 3¼ pounds
im milk are equal to one pound of corn, we find
per acre of peanuts, assisted by 2552 pounds of
or its equivalent there was made an increase of
pounds in live weight. Deducting the amount at-
table to the grain, 510 pounds, we have a balance
2 pounds of pork as the equivalent of one acre of
uts, then worth, at 4 cents per pound, $17.28.

anuts and corn meal for shoats in 1902.—Another
of 7 shoats was penned on Spanish peanuts from
ber 11, 1902 to November 2, 1902. Their average
ht at the beginning was nearly 100 pounds each.
made a growth of 224.5 pounds while consuming
pounds of corn meal and the peanuts on .47 of an
To produce a pound of growth required only
ounds of corn meal. This gain is at the rate of
pounds of live pork per acre of peanuts assisted
32 pounds of corn meal. Assuming that five
ds of grain would make one pound of growth
ave left 360.5 pounds of growth which we may
oute to one acre of peanuts alone. These shoats
sold after further experimental feeding and
ght five cents on foot, making the acre of peanuts
h $18.02.

ains made by very small pigs on peanuts alone.

litter of seven Poland China pigs was weaned Sep-
er 4, 1901, and immediately hurdled on Spanish
uts.

ter a week allowed for them to become accustomed
eir new food, the experiment proper began, and
nued for six weeks, during which time no grain
fed. The initial weight averaged 28.1 pounds. The

gains in six weeks aggregated 156.5 pounds, which
at the rate of a little more than half a pound per d
per pig. The area grazed was 13, 887 square feet. Th
is equivalent to a gain of 503 pounds of live pork p
acre of peanuts, worth, with pork at 4 cents, $20.12.

When taken from peanuts October 31, 1901, one
these pigs, No. 12, was butchered and the melting poi
of the lard determined.

Peanuts and corn meal in 1899.—On September
1899, a lot of seven shoats previously supported
sorghum and on a diet of corn and cowpeas (see p. 1
was transferred from sorghum to Spanish peanuts, a
to make a properly balanced ration the grain w
changed to corn meal.

During the next four weeks the lot of seven pi
made gains of 120.7 pounds while consuming 333 poun
of corn meal and the peanuts on 10,593 square fe
This is at the rate of 496 pounds of growth produc
by an acre of peanuts assisted by 1356 pounds of co
meal. If 5 pounds of grain alone would have produc
one pound of growth there remains 225 pounds
pork, worth $9.00, as the value of an acre of peanu
converted into pork. Besides the peanuts there w
required 2.73 pounds of corn meal to produce a pou
of growth.

A week after the close of this period these seven pig
all of one litter, were divided into several lots, one l
continuing to graze on peanuts, a second lot grazing
chufas with grain as stated further on, a third lot bei
penned and fed on a mixture of cotton seed meal a
corn meal, and the remaining pig together with one
a different litter being fed in a pen on corn meal alon

.*Peanuts and corn meal in* 1899, *second period.*—For ive weeks certain of these pigs were hurdled on a field of Spanish peanuts. During the last three weeks of his grazing period they gained in weight at the rate of 293 pounds per acre of peanuts, assisted by 274 pounds of corn meal, or one pound of growth for .94 of a pound of corn meal. Crediting the corn meal as before we have left 247 pounds of pork, then worth $9.88, as apparently attributable to one acre of peanuts.

GAINS MADE BY YOUNG PIGS ON CHUFAS.

From November 19 to December 17, 1898, nine Berkshire pigs were hurdled on a field of chufas where there was only a poor stand of plants. They were also fed a little grain, mixed corn and cowpea meal, of which only 262 pounds was fed during the four weeks. The increase in weight was 121.1 pounds and the area grazed over was 7986 square feet. This is at the rate of 660 pounds of live pork per acre of chufas assisted by 1429 pounds of grain or one pound of growth for 2.17 pounds of grain. Attributing one pound of growth to five pounds of grain we have left 374 pounds of increase in live weight as apparently due to one acre of peanuts alone. Hogs were then selling at 3½ cents per pound on foot, so that the acre of chufas when converted into pork was worth $13.09.

PEANUTS VERSUS CHUFAS VERSUS MIXED GRAIN.

Four lots of pigs (from litters N and P.) were fed for twenty-five days, October 19 to November 13, 1900, as follows:

Lot A.—Spanish peanuts, grazed, and a half ration of mixed grain.

Lot B.—Spanish peanuts grazed, without grain.

Lot C.—Chufas grazed and a half ration of mixe
grain.

Lot D.—Mixed grain alone, fed in bare lot, as muc
grain as shoats would clean up.

The grain fed to Lots A. C. and D., consisted of on
third by weight of ground cowpeas and two-third
ground corn.

The table below gives the data for the last 18 day
of the experiment, the preceding week being regarde
as preliminary and as needed to fully accustom all lot
to their food. At the beginning of the experimen
proper lots A, B, C, and D, weighed respectively 36
256, 318 and 392 pounds.

Growth made by each lot of 3 pigs and food consume
in 18 days.

Lot.	Area grazed.	Food.	Grain eaten.	Incr'ase in live weight.	Lbs. grai for 1 lb. growth.
	Square ft.		*Lbs.*	*Lbs.*	*Lbs.*
A	8,344	Spanish peanuts, grazed Mixed grain, ½ ration..	152	81	1.88
B	12,448	Spanish peanuts, grazed	....	22	....
C	7,937	Chufas, grazed .... Mixed grain, ½ ration..	152	79	1.92
D	....	Mixed grain, full ration	304	70 5	4.31

Chufas and peanuts in this test were nearly on a
equality, and when half a ration of grain was fed wit
either there was required only 1.92 or 1.88 pounds o
grain to produce one pound of groth. As compare
with the exclusive grain ration this represents a sa
ing of 56 per cent of the grain by the use of eithe
chufas or peanuts.

Spanish peanuts without grain afforded a very slo
growth, and the increase in live weight was only 76

for each acre of peanuts. This is an abnormally
urn and due in part to the poor growth and
nd of peanuts.
live pork at 4 cents per pound this gives only
the returns per acre when no grain was fed,
entirely unsatisfactory.
ch larger return was made when peanuts were
ented with a half ration of grain. With lot A,
due jointly to one acre of peanuts and to 791
of corn was 423 pounds of live pork. Dividing
unt of grain fed to this lot by 4.31, the amount
per pound of growth when nothing but grain
we have 184 pounds of live weight as apparently
the grain fed; subtracting this from the total
in live weight we have left 239 pounds as the
of growth that we may credit to one acre of
With pork at 4 cents per pound this gives
the value of an acre of peanuts converted into

re of chufas supplemented by 832 pounds of
oduced 433.5 pounds of live pork and by the
ocess as above we calculate that one acre of chu-
ld be credited with 240½ pounds of pork, or

xperiment agrees with a previous one, reported
ma Station Bulletin No. 83, p. 118, in showing
s more profitable to feed some grain to small
razing on peanuts than to require them to make
ire growth from the nuts.
ollowing table shows the daily gain per pig,
n consumed daily per 100 pounds of live weight
number of days of pasturage afforded by one
peanuts or chufas. In calculating the last
mns the average of the live weight at the be-
and end of the experiment has been used.

Peanuts and chufas as pasturage.

Lot.	Food.	Daily gain per pig	Grain consumed daily per 100 lb. live weight.	Pastura on 1 ac for a 10 lb. sho
		Lbs.		*Days.*
A	Peanuts, and ½ grain ration..	1.50	2.58	850
B	Peanuts, alone.	.41	....	463
C	Chufas and ½ grain ration....	1.46	2 99	827
D	Full grain ration.............	1.31	4.67	....

The rate of gain, nearly one and one-half pounds p day per head, was satisfactory except for the lot recei ing no grain, with which the daily growth was only .4 of a pound per head.

The second column shows that when shoats we "hogging off" peanuts or chufas they made good use 2.58 pounds and 2.99 pounds respectively of grain dai for every hundred pounds of live weight.

The third column shows that an acre of peanut without grain, afforded pasturage at the rate of 46 days for a hundred pound shoat, which is equal to 1 such shoats for one month. In 1899 when receivin about one-fourth of a normal grain ration pigs grazin on inferior peanuts made moderate gains when th field was stocked at the rate of 13 100-pound shoats f one month. When a half ration of grain was fed th peanuts or chufas lasted nearly twice as long, the ra of pasturing per acre for every 100 pounds of li weight being 850 days for peanuts and 827 days f chufas, equal to the support for one month of 28 10 pound shoats on an acre of peanuts and of 27 on a acre of chufas.

'FFECTS OF PEANUTS, CHUFAS AND COWPEAS ON FIRMNESS OF LARD.

t the conclusion of the two experiments just de-bed one barrow from each of the four lots was killed, ember 14, 1900, and lard rendered from the fat taken 1 the jowl of each. The melting points of these ples of lard were determined by Prof. C. L. Hare of Chemical Department.

ct of peanuts and chufas on melting point of lard.

Food during 26 days before butchering.	Food fed prior to 26 days before butchering.	Melting point of fat. Deg's C.	Melting point of fat. Deg's F.	Increased hardness over lot B Deg. F.
Peanuts, ground cowpeas and corn.	Sorghum grazed Ground cowp's & corn	28.0	82.4	10.8
Peanuts, alone	Sorg'm graz'd; pean'ts	22 0	71.6	....
Chufas and ground cowpeas and corn..	Cowpeas grazed......	27 5	81.5	9.9
Ground cowpeas and corn..............	Ground cowpeas and corn	30.0	87.0	15.6

ne half ration of one-third cowpeas and two-thirds meal fed to lot A, for several months immediately re butchering raised the melting point 10.8 F. the lard of pigs fed partly on peanuts as compared pigs that had received no grain, but only peanuts several months. This grain ration fed alone to D afforded a lard which was firmer by 15.6 de-s F. than that from pigs which up to the day when d had consumed peanuts.

this test sorghum shows no marked tendency to n the lard, at least when its use was discontinued ly a month before the hogs were killed. Additional are required to determine its effect, if any, in this ect when fed up to the last day.

The cowpea evidently afforded a rather firm lard, but our tests do not show exactly how it compared with corn in this respect.

GRAZING SORGHUM AND COWPEAS.

September 14th, 1900 twelve pigs recently weaned (litters N and P.) were divided into four lots of three pigs each. The different lots were quite evenly matched in all essential respects and weighed respectively 175.5, 176.5, 170.5 and 193 pounds per lot. The experiment lasted five weeks in addition to the preliminary period.

Lot A was confined by means of movable hurdles on drilled sorghum, in dough and ripening stages, and was supplied with what was regarded as a half ration of a mixture of two-thirds corn meal and one-third cowpea meal by weight.

Lot B was penned on sorghum alongside of lot A; no grain was furnished to this lot, but instead ripe Spanish peanuts were pulled and thrown in the pen daily in quantities estimated as furnishing about a half ration of peanuts.

Lot C was hurdled on drilled Whippoorwill cowpeas on which the pods were ripe, and this lot received no other grain.

Lot D was confined in a small bare pen and furnished with as much as the pigs would consume of the same grain mixture as that supplied to lot A.

Grain eaten, area of sorghum, cowpeas, and peanuts grazed, and growth made in five weeks by three pigs in each lot.

Lot.	Food.	Grain eaten.	Increase in live weight.	Lbs. grain for 1 lb. growth.
		Lbs.	*Lbs.*	*Lbs.*
A	Corn and cowpea mixture...	244	74.5	3.28
	4872 sq. ft. of sorg'm, grazed	....	....	....
B	4872 sq. ft. of sorg'm, grazed	....	53 5	....
	29005 sq. ft. of Sp. peanuts.	....	....	....
C	17964 sq. ft. ripe cowpeas...	....	50 5	....
D	Corn and cowpea mixture ..	464	124	3 74

tly sorghum was in this case of very slight r with lot A sorghum saved only 12 per cent rain required by lot D to make a pound of Equally unsatisfactory was the growth of iich was made to subsist entirely on sorghum nted by peanuts grown without fertilizer be- rn rows on very poor sandy land.

grew at the rate of 122.5 pounds of live weight of cowpeas, which, at 4 cents per pound, gives the value of an acre of a moderate crop of ripe when converted into pork.

aste was very great, the peas falling on the ınd sprouting before being consumed. In a xperiment (Bulletin No. 93) in which some furnished to shoats grazing on nearly ripe the results were far more satisfactory, one acre as assisted by 1578 pounds of corn making 730 f live pork. If we assume that each five pounds formed one pounds of growth, we have 336 f live pork, worth at 4 cents $13.44, as the value e of cowpeas alone converted into pork in that le in this one an acre of cowpeas alone made s.

made a very satisfactory growth on the mix- ne-third cowpea and two-thirds corn meal, only ıds of this mixture being required to make one growth. The rate of growth was several times id than with the pigs dependent entirely upon or upon sorghum and peanuts, and considerably id than with lot A, which received a limited grain and an unlimited supply of sorghum.

erage daily gain per shoat was 1.18 pounds ull ration of mixed cowpea and corn meal was average daily consumption of this grain *per d of live* weight was 5.19 pounds.

COTTON SEED MEAL IN THE GRAIN RATION.

November 13, 1900, after the conclusion of the periment just described, one pig from each of lots C, and D was kept for five weeks on an exclusive gr diet made up of one-fourth by weight of cotton s meal and three-fourths corn meal. They were given they would eat but did not relish the food.

During the five weeks they gained 67.5 pounds, req ing 4.68 pounds of food per pound of growth. Thi an average daily gain of .64 of a pound per head. N the end of the fifth week the attendant noted the thrifty appearance of the pigs, but no death occurred

The amount of cotton seed meal which had produ sickness but not immediate death, was 25.5 pounds shoat of an average weight of 117.6 pounds. Hence toxic dose of cotton seed meal was here, per 100 pou of live weight, 21.4 pounds, of .61 of a pound per for 35 days.

After eating this grain, containing 25 per cent cotton seed meal, for five weeks the pigs were slau tered and a sample of lard from the fat of the body examined by Prof. C. L. Hare, who found the melt points to be as follows:

Melting point of lard from cotton seed meal ratio

Lot.	Food during last 5 weeks of life.	Food second month before butchering.	Melt poin la Deg
B	¼ cotton seed meal.. ¾ corn meal..	Peanuts, alone	87
C	do	Chufas, &c. ⅓ cowpea meal ⅔ corn meal..	82
D	do	Full ration ⅓ cowpea meal ⅔ corn meal...	84

ard from some pigs in lot B had melted at 71.6°
nediately after the pigs were taken from a peanut
; now, after five weeks feeding of a ration con-
25 per cent of cotton seed meal, the melting
as risen to 87.4 degrees, a hardening effect of
grees attributable to this food. This cotton seed
nd corn meal mixture did not very greatly in-
the hardness of the lard of the lots which had
eceiving a partial or exclusive grain ration
ımber of weeks before the cotton seed meal feed-
s begun.

SEED MEAL (25 PER CENT) IN THE RATION OF PIGS.

e fall of 1899 three Poland China shoats from
e litter, previously maintained on peanuts with
ration of corn meal, and an Essex pig previously
ing ordinary pasturage and corn, were penned.
the Poland Chinas were fed all they would eat
xture of one-fourth cotton seed meal and three-
corn meal. The third Poland China and the
hoat were fed in separate pens on corn meal

ure of cotton seed meal and corn meal versus corn meal alone.

Food.	Average weight per pig during experiment.	Growth per pig.	Grain eaten per pig.	Lbs grain per lb. growth	Daily ration per 100 lbs. live weight.	Daily growth per pig.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
) {¼ cotton s. meal, ¾ corn meal. . .	113 1	14.3	97.7	7 11	2.46	.41
) Corn meal	121 5	21	128 8	6.13	3 02	.60
Corn meal.	97.5	58 5	200.0	3.43	5.86	1.67
Corn meal	109.5	39 7	164.4	4 13	4.28	1 13

None of the Poland China pigs (lots 3 and 4) a sufficient grain for rapid growth when changed fr peanuts to an exclusive grain diet. As a result of t small daily consumption of food slow growth was ma by lots 3 and 4, with the almost inevitable result th the increase in live weight was made at a financial lo It required 7.11 pounds of the mixture containing c ton seed meal or 6.13 pounds of corn meal alone to ma one pound of growth, both figures showing unsatisfa tory rates of growth.

The cotton seed meal mixture was decidedly u profitable, but up to five weeks it was not preceptibly i jurious to health. During these 35 days the amount cotton seed meal consumed per 100 pounds live weig was .61 of a pound daily or a total of 21.5 pounds.

EFFECT OF PEANUTS, CHUFAS, CORN MEAL AND COTT SEED MEAL ON QUALITY OF LARD.

After the conclusion of certain experiments p viously described, (grazing peanuts and feeding c ton seed meal in comparison with corn meal) the pi thus fed were butchered.

Samples of the lard made from the bodies of these pi and from others which had subsisted for some mont on chufas, supplemented by a light ration of grain, we tested by Prof. C. L. Hare of the Chemical Departme to learn the temperature necessary to melt the lard.

Melting point of lard from various foods.

Pig No.	Food during 5 weeks just before butchering.	Food fed prior to 5 weeks before butchering.	Melting point of fat.	Average melting point of fat
			Degrees F.	*Degrees F.*
84	Peanuts....	Peanuts	73 5	....
86	Peanuts............	Peanuts......	75.7	....
Av. 84 & 86	Peanuts............	Peanuts......	....	74.6
87	Chufas	Peanuts......	75.2	....
89	Chufas	Peanuts......	74.6	....
Av 87 & 89	Chufas	Peanuts......	....	74.9
88	¾ corn meal, ¼ cotton seed meal ...	Peanuts......	84.2	....
90	¾ corn meal, ¼ cotton seed meal....	Peanuts......	84	....
Av. 88 & 90	¾ corn meal, ¼ cotton seed meal....	Peanuts......	....	84.
85*	Corn meal..........	Peanuts......	80.7	80.7
E.	Corn meal (Essex)..	Corn and grass pasturage..	86.0	....

*This pig was from same litter as Nos. 84 ,86, 87, 88, 89 and 90.

It is well known that peanuts produce a soft lard. When the feeding of peanuts was continued uninterruptedly up to the date of slaughter the resulting lard melted at the low temperature of 74.6 degrees Fahrenheit, or at the temperature of an ordinary living room in spring. It has been claimed that by feeding entirely on corn for a few weeks before the date of butchering, the flesh and lard can be brought to the normal degree of hardness. This was not the case in this experiment. By discontinuing the peanuts five weeks before the hogs were killed and feeding thenceforward exclusively on corn meal we succeeded in raising the melting point to 80.7 degrees Fahrenheit, an increase of 6.1 degrees Fahrenheit. This lard, however, was still much softer than that from hogs never fed on peanuts. In a similar experiment in 1897-'98 (see Bulletin No. 93) the feeding of corn during the four weeks imme-

diately preceding the time of butchering effected a con siderably greater increase in the melting point of lar from the pigs previously fed on peanuts, but in tha test as in the present one, the feeding of corn durin a short period did not make the resulting lard equal i firmness to that made by continued feeding of corn.

In this experiment the lard produced by feeding chu fas was practically as soft as that obtained from peanut fed pigs.

After ascertaining in a previous experiment that th melting point of lard from peanut-fed pigs could not b raised to the normal degree of firmness by feeding ex clusively on corn during the month immediately pre ceding death, search was made for some food whic might have a greater effect in solidifying the flesh an lard. Cotton seed meal seemed worthy of a trial fo this purpose as it has been shown to increase the firm ness of butter, and as a few determinations appear t indicate that it produces tallow and suet with a hig melting point. Unfortunately no safe method of feed ing to hogs for a long period any considerable proportio of cotton seed meal has yet been entirely demonstrated In small amounts it may be fed for four weeks, or even little longer without causing death.

In this experiment a mixture of one pound of cotto seed meal to three pounds of corn meal was fed durin the five weeks before the date of butchering to pig which prior to this time had grazed on peanuts. Th effects of the food containing cotton seed meal was t raise the melting point of the resulting fat to 84.1 de grees Fahrenhiet. This is a gain of 9.5 degrees as com pared with an uninterrupted diet of peanuts. The cot ton seed meal mixture afforded lard which required fo melting a temperature of 3.4 degrees Fahrenheit highe

an that necessary with fat produced by feeding corn eal alone during the same length of time.

The result of this experiment is encouraging as indi-ating the superior hardening power of a mixture of otton seed meal and corn meal over corn meal alone. he lard from the pigs fed for six weeks on this mix-ire was practically as firm as that obtained in this ex-eriment from an Essex pig that had never eaten pea-its, but it was not so firm as the lard produced in the orresponding experiment of 1897-'98 from pigs fed un-terruptedly on corn. (See Alabama Station Bulletin o. 93, p. 30.)

OTTON SEED MEAL AS FOOD FOR HOGS IN CONNECTION WITH CORN MEAL AND SORGHUM OR PEANUTS.

On September 14, 1901, a litter of six thoroughbred oland China pigs, farrowed April 2, was divided into ree lots and these were fed as follows:

Lot I, grazed on drilled sorghum, (blooming to ripe age), and a half ration of grain, as below.

Lot II, in dry lot, fed sorghum from same field, cut to lenghts of 1 to 2 inches, and also fed grain like t 1.

Lot III, grazed on Spanish peanuts and given same ain as other lots.

All three lots received in addition to sorghum or pea-its a mixture of one-fifth cotton seed meal and four-fths corn meal, which was not greatly relished and of hich the pigs in a dry lot could not be induced to eat much as was desirable. This lot also ate far less rghum than was desired.

After a week of preliminary feeding the experiment egan September 20 and continued until the last week October.

Sorghum, grazed and soiled, versus peanuts graze

Lot.	Pig No.	Weight Sept. 20 Each.	Weight Sept. 20 Total.	Food.	Daily gro'th per pig.	Total growth.	Grain consumed.
					Lbs.	Lbs.	Lbs.
I	1 2	61. 74.5	135.5	Sorghum grazed; cotton seed meal & corn meal.	.53	36	140
II	3 4	67 57.5	124.5	Sorghum in pen; cotton seed meal and corn meal	.11	8.5	94
III	5 6	71 64.5	135.5	Peanuts grazed; cotton seed meal & corn meal.	.94	72.5	134

During the experiment lot I grazed over (with g waste) 2203 square feet of sorghum and lot 3 consu the peanuts on 3880 square feet; 782 pounds of gr cut sorghum were offered to lot II but only 372 pou were consumed. Reducing these results to the b of one acre we have the

Growth made on one acre of sorghum or peanut

	Pasture Crops.	Growth per acre of green food.	Grain per acre of green food.	*Gro attri ble acre g foo
		Lbs.	Lbs	Lt
Lot I.	Sorghum grazed; and grain..	707	2768	1.
Lot II.	Sorghum fed; and grain.....	210	2323	lo
Lot III.	Peanuts grazed; and grain..	814	1504	5

* On the assumption that 5 lbs. of grain made 1 pound of growt

To produce one pound of growth, there was requ 3.8 pounds of grain in connection with sorghum turage, only 1.85 pounds of grain in connection peanuts and 11.05 pounds of grain when cut sorgl was fed in a dry lot.

financial results are quite satisfactory for pea- ne acre of which is estimated as producing 513 of live pork, worth at 4 cents per pound, $20.52. eof sorghum grazed is estimated as affording 153 of live pork worth $6.12, while sorghum fed to a pen was consumed in quantities too small to y measureable financial results.

t of a 20 *per cent. cotton seed meal mixture on of pigs.*—A mixture of one-fifth cotton seed meal ur-fifths corn meal was fed as just stated, in ion with sorghum or peanuts continuously from ber 14. All went well until October 24, when 1 in lot II died suddenly. Three days later the ig in lot 1 died and also both pigs in lot II. Oc- 8 the use of cotton seed meal was discontinued t III, which had thus far shown no symptoms or s or unthriftiness, but which, as the subsequent of one of these pigs shows, had been injured by of cotton seed meal. One of these pigs, No. 6, from grazing on peanuts was used in a subsequent ex- nt, in which he died, though not given any more seed meal. The other one was butchered October samples of fat were taken from this one, as well as ne of the pigs that died in each of the other two

us calculate the amounts of cotton seed meal onstituted a dangerous ration when fed for about ks.

Amounts of cotton seed meal causing death of shoat when fed with corn and sorghum or peanuts.

	Lot I. Mixed grain and sorghum (grazed.)	Lot II. Mixed grain and sorghum (fed.)	Lot III Mixed grain an peanuts (grazed.
	Lbs.	*Lbs.*	*Lbs.*
Total grain per head daily............	2 06	1 27	1 76
Total grain per 100 lbs. av. live weight	2.67	2 00	2 05
Cotton seed meal per head daily......	.41	.25	.35
Cotton seed meal daily per 100 lbs. av. live weight....	.53	.40	.41
Total amount cotton seed meal (incl'g preliminary week)	16.60	12 20	15.20
Total amount cotton seed meal per 100 lbs. av. live weight	21.60	18.90	17.70

From this table it may be seen that a daily ration containing one-fourth pound or more of cotton seed mea per 100 pounds of average live weight was fatal whe continued for about six weeks. No deaths occurred unti the small shoats (averaging about 64 pounds) had eac consumed 12.2 pounds of cotton seed meal. Per 10 pounds of liveweight the minimum fatal quantity wa 18.9 pounds.

EFFECTS OF A 20 PER CENT COTTON SEED MEAL MIXTURE AN OF SORGHUM AND PEANUTS ON MELTING POINT OF LARD.

Lard was rendered from samples of fat taken fro the neck and also from around the kidneys of one pig i each of the lots just referred to. The melting points c the lard were as follows:

Effect of cotton seed meal on melting point of lard.

Food.	Lard from kidneys	Lard from jowl
	Deg. F.	Deg. F.
Sorghum grazed; ½ ration of { $\frac{1}{5}$ cotton seed meal.. / $\frac{4}{5}$ corn meal........	115.2	87 4
Sorghum fed, do	115 2	85.3
Peanuts grazed, do	99.7	80.6

It is evident that peanuts afforded a much softer lard than did sorghum, even when each constituted only about half the ration. The feeding of somewhat less than a half ration of mixed cotton seed meal and corn meal (1 to 4) for five weeks while peanuts were being grazed, failed to overcome the softening effects of peanuts.

In two experiments already recorded in this bulletin the body lard from pigs getting only peanuts melted at temperatures of 74.6 and 71.6 degrees Fahrenheit; the feeding of a small amount of a mixture of cotton seed meal and corn meal for five consecutive weeks while peanuts were being eaten in this test raised the melting point to 87.4 degrees, a gain of 12.8 and 15.8 degrees.

This increase of 12.8 to 15.8 degrees in hardness is somewhat greater than had previously resulted from feeding a stronger cotton seed meal mixture for six weeks after the peanuts were discontined (see Experiment on p. 29.)

On the whole these experiments viewed together indicate that greater hardening effect results from the grain when fed with the softening food (as peanuts or chufas) than from that fed as the exclusive ration in the six weeks just before the date of butchering. This is also practically the conclusion reached by Bennett in Arkansas Bulletin No. 65.

COTTON SEED MEAL VERSUS COWPEA MEAL AND VERSUS CORN MEAL AS A FINISHING FOOD.

Six pigs from one litter which had subsisted for six weeks after weaning on a field of Spanish peanuts without any grain, were later divided into three lots and fed for 37 days (including the preliminary period of 7 days) as much as they would eat of the rations mentioned below:

Food consumed and growth made in 30 days.

	FOOD.	Grain eaten.	Growth made.	Lbs. grain per lb. growth.
		Lbs.	*Lbs.*	
Lot III	⅓ cowpea meal, ⅔ corn meal....	95.3	19	5.00
Lot IV.	Corn meal	140 0	29	4.82
Lot V.	⅕ cotton seed meal, ⅘ corn meal ...	92 0	16.5	5.57

All three lots made but slow growth, which we may attribute in the case of lots III and V to the relative unpalatability of the mixture containing either cowpeas or cotton seed meal. Corn meal was more relished and hence in this brief experiment more satisfactory, though in previous experiments a mixture of cowpeas and corn has been superior to either alone, and especially so when the feeding period has been a long one.

EFFECTS ON HEALTH.

After 37 days' feeding of the 20 per cent. cotton seed meal mixture, No. 13, one of the pigs in Lot V, died after having appeared gaunt and weak for two days.

This death and the unthrifty appearance of the other

pig receiving cotton seed meal notified us that it was time for the experiment to close. The pigs in the other pens remained healthy. All were butchered as soon as the experiment was stopped, and samples of fat were taken and rendered into lard.

Up to the time of the death of one pig and the evident unthriftiness of another, the pigs in Lot V, averaging at the middle of the period 59.4 pounds per head in weight, had each consumed since the seventh of November 5.4 pounds of cotton seed meal. This is equivalent to saying that toxic effects were evident when for each 100 pounds of average live weight 9.2 of cotton seed meal had been consumed. During the experiment proper the average daily consumption of cotton seed meal was .25 of a pounds per 100 pounds of live weight. It will be recalled that when the same mixture was fed in an earlier experiment to somewhat larger, but young shoats, the daily consumption of .41 of a pound per 100 pounds live weight resulted fatally. In a still earlier experiment with still larger shoats, cotton seed meal was consumed at the rate of .61 of a pound daily per 100 pounds of live weight, for 35 days; no immediate conspicuous injury resulted, and observations on subsequent effects were prevented by the disposition made of the pigs.

Effects on quality of lard of small shoats fed on cowpea meal and cotton seed meal.

Lot.	Pig No.	Food for last 37 days of life.	Food from Sept. 14 to Oct. 31.	Lard from kidneys Degrees F.	Lard from jowl. Degrees F.
......	12	Peanuts alone......	Peanuts [kil'd Oct.31]	82.6	68.2
III.	11	1/3 cowpea meal... 2/3 corn meal.....	Peanuts....	81.5	72 0
III.	8	do	do	79 9	72.5
III.	Av.	do	do	80.7	72.3
IV.	10	Corn meal.	do	88.3	78.8
IV.	9	do	do	77 2	72.4
IV.	Av.	do	do	82.7	75.6
V.	7	1/5 cotton seed meal 4/5 corn meal......	do	90.0	70.3
V.	13	do (died.)	do	83.3	64.4
V.	Av.	do	do	86.7	67.4

The lard from all lots had a very low melting poin for grain fed animals, probably due in part to smal size and extreme immaturity of the pigs as well as t the softening effects of peanuts in an earlier period. We may safely discard the melting point of the jow lard fat of Lot V, as probably being influenced by ac cidental conditions, possibly by variations in the per centage of moisture or other impurities left after rend ering. Shutt has observed that unthrifty pigs have sof pork, which condition may constitute the explanatio of the low melting points in Lot V.

The kidney lard was firmest when the cotton see meal mixture was fed, the advantage in favor of this foo being 4 degrees F. as compared with corn meal.

meal afforded a slightly firmer lard, both from and jowl, than did a mixture of cowpeas and eal.

mpared with the lard obtained from No. 12 (imly after feeding peanuts), the cowpea mixture nmeal scarcely affected the melting point of the lard, but increased that of the jowl lard by 4.1 degrees F. respectively.

otton seed meal mixture raised the melting point ey lard 4.1 degrees F. above that of pure peanut m kidney fat.

rently 37 days was too short a period for any of n foods to thoroughly harden pork once softened uts. The tendency of our experiments and of ade by Bennett, in Arkansas, is to show the need ger hardening period than is generally regarded ssary, or else the feeding of some grain while nuts are being consumed.

SEED MEAL MIXTURE VERSUS CORN MEAL—FOURTH EXPERIMENT.

s which had grazed for 23 days on peanuts in , 1902, were then penned and divided into two ne lot was fed on corn meal alone, the other on re of three-fourths corn meal and one-fourth cotl meal. The average weight per shoat during eriment was 136.3 pounds for those getting corn nd 142.8 ponuds for those on the cotton seed et. The amounts of food consumed by the two re practically identical. Omitting the prelimiriod, the results for the next 28 days were as :

	Daily growth per pig.	*Grain, per lb. growth*
	Lbs.	*Lbs.*
l	1 1	5 31
seed meal, ¾ corn meal	.8	3 84

In this experiment the rations containing 25 per ce of cotton seed meal caused much more rapid and e nomical growth than corn meal alone.

Throughout the 31 days during which cotton se meal was fed the health of the shoats was good. T shoats getting the mixed rations consumed daily, p 100 pounds of mean live weights, .73 of a pound of c ton seed meal. Their total consumption of cotton se meal in 31 days, including the preliminary period, w 22.6 pounds per 100 pounds of live weight.

Comparing this result with those previously record let us note the increasing amount of cotton seed me per 100 pounds of live weight which may be safely f as the pigs increase in size.

EFFECT OF COTTON SEED MEAL, CORN MEAL, AND RICE PO ISH ON LARD.

In the following table are recorded the results of terminations, made by Mr. A. McB. Ransom of t Chemical Department, of the melting point of lard fro the jowls.

The pigs were Poland Chinas from the same litt but were not butchered on the same date.

Melting point of lard.

		Food during 31 days before slaughtering.	Food from 55th to 32d day before slaughtering.	Melti poin of bo lar Deg.
Lot F.	No. 101	Corn meal............	Peanuts & corn meal.	76.
"	No. 102	do	do	79.
"	Average	do	do	78.
Lot G.	No. 103	1/4 cotton seed meal, 3/4 corn meal.......	do	80
"	No. 104	do	do	82
"	Average	do	do	81.
	105	Rice polish [last 8 weeks]	Peanuts and corn meal [23 days]!	74.
	106	Rice polish [8 weeks]	Grain ration	78.
	107	Corn meal [8 weeks]..	Grain ration..........	85.
	108	Corn and skim milk *	Peanuts & corn meal, [23 days]...........	76

*Only small amounts of skim milk were used and for only 19 days

his test the feeding for 31 days of corn meal raised
elting point of lard (previously softened by pea-
by only 3.8 degrees F. The feeding for the same time
ixture containing 25 per cent. of cotton seed meal
the melting point by 7.2 degrees F. The lard af-
by the cotton seed meal ration was firmer than
rom corn meal, the melting point of the former
degrees F.) being 3.4 higher.

last result, together with other experiments de-
l in previous pages, indicates that cotton seed
has an appreciable value for hardening the lard
oubtless also the flesh of pigs raised on peanuts,
, and most other softening foods. This will be
portant point in its favor when hog raising for
s well as for home consumption, becomes an im-
t industry in Alabama; for the buyer for a pack-
use will not knowingly buy hogs with soft flesh.
e is every reason why those sections of Alabama
peanuts thrive should at no distant date ship car-
f hogs to packing houses in Birmingham, Atlanta,
rleans, or other markets, provided the flesh can be
ed. In many counties the sale of hogs and
products could easily be made to bring in as
money as the cotton crop. Cholera is not an in-
ble obstacle. Keeping hogs off the public range,
from flowing streams of cholera-infected water,
lerstanding of the nature and means of spreading
disease, and judicious feeding and care, will
reduce this danger.

raising requires little capital and brings its re-
quickly. Improved blood, food, care, and knowl-

edge are capable of making the Alabama hog, as we as his relative in the corn belt, a "mortgage lifter."

SWEET POTATOES FOR HOGS.

From November 13 to December 18, 1900, a period 35 days, two shoats were penned on sweet potato growing on poor sandy soil, and furnished daily p head with 2 pounds ground corn and 1 pound groun cowpeas, which was regarded as a half ration. Tl total weight at the beginning of the test was 231 pound and during the five weeks the two shoats made a tot gain of 67 pounds, requiring besides sweet potatoe 3.13 pounds of grain per pound of growth.

The potatoes were not eaten with much relish, an after being rooted up they were left on the surface, son of them remaining there until they decayed. Probabl the waste would have been less if less grain had bee fed. The composition of the sweet potato leads us expect that it would be advisable not at any time confine shoats to sweet potatoes alone, but to give the while on the potato field a little nitrogenous food, suc as cowpeas, peanuts, etc.

CARTS VERSUS COWPEA MEAL VERSUS CORN MEAL.

period of seven weeks, in addition to a week of
ary feeding, in January and February, 1899,
d stuffs were compared, each being fed in con-
with an equal weight of rice bran obtained from
Co., New Orleans. There were three lots of re-
eaned pigs, each lot containing three pigs. All
except one were from the same litter, and were
d Berkshire—Poland Chinas.

nusually cold weather of this time, inadequate
, and the rather unpalatable nature of all the
due to the admixture of rice bran, made the
growth slow and unsatisfactory.

Growth and food eaten in seven weeks.

Food.	Total growth, lbs.	Food eaten, lbs.	Lbs. food per lb. growth.
% corn hearts and 50% rice bran..	65	479.5	7.38
% cowpea meal and 50% rice bran.	80.6	478.5	5.95
% corn meal and 50% rice bran....	98.1	540.0	5.50

ation containing corn meal was the most effect-
probably because of its greater palatability,
e larger amount consumed.

ding to partial analyses made in the chemical
ry here the rice bran used contained 9 per cent.
in, and the corn hearts 8.9 per cent. of protein.

RICE POLISH AS A FOOD FOR PIGS.

igh price of corn during 1902 made it desirable
or some substitute in addition to such materials
e grown on the farm. Hence rice polish was em-
n a number of experiments and was tested in
son with corn meal. In different experiments
o foods were used alone or each combined with
nding proportions of other foods. Each lot con-

sisted of three pigs, usually recently weaned. In a
cases the food was fed dry.

Rice polish versus corn meal in connection with ski milk.—In the first experiment, made in the spring 1902, skim milk was fed in connection with either co meal or rice polish. The results were as follows:

Food.	Growth, 3 pigs, in 5 weeks.	Lbs. grain per lb. growth.	Lbs. skim milk
Corn meal and skim milk............	89.5	2.1	4.
Rice polish and skim milk...........	109.0	1.7	3.

It will be seen that in connection with skim milk, ri polish was more effective, pound for pound, than co meal.

Rice polish versus corn meal alone, first experimen At the end of the fifth week the skim milk was dropp from the ration of both lots and the rate and econon of growth were immediately greatly decreased, as show below.

It then required to make one pound of growth 6 pounds of corn meal or 6.7 pounds of rice polish. this test, in which the conditions were unfavorable rapid gains, the rice polish and corn meal were of equ value.

Rice polish versus mixed grain.—The following te was made with a different litter of pigs just after wea ing. The experiment covered, in addition to the pr liminary period, five weeks, terminating June 11, 190 There were three pigs in each lot.

The mixed grain consisted of one-half cowpea me one fourth corn meal, and one-fourth rice polish. Th was fed in comparison with a grain ration of rice polis the pigs of both lots receiving in addition a nearly equ amount of skim milk.

	Lbs. grain per lbs. growth.	Lbs. milk per lb. grow
Lot B—Mixed grain and skim milk..	1.78	4.13
Lot C—Rice polish and skim milk....	1.93	4.74

be noticed that mixed grain consisting partly
a meal, and hence very rich in nitrogenous ma-
oved superior to rice polish.

lish in different proportions.—During the next
s the grain mixture for lot B remained the
mely 50 per cent. cowpea meal, 25 per cent.
l and 25 per cent. rice polish.

ain of lot C, was so changed as to consist of
ts of corn meal and rice polish.

ive of the preliminary period the results were
s:

	Lbs. grain per lbs. growth.
cowpea meal	
corn meal	5.0
rice polish	
corn meal	4.2
rice polish	

st was made during mid summer and the pigs,
in small, bare yards and deprived of green food,
nake as rapid or as economical growth as they
oubtless have done under more natural condi-
dinarily we should expect that for young pigs
nitrogenous mixture fed to lot B, would prove
as it did in the test described immediately

Rice polish versus corn meal alone.

a third period of five weeks terminating Au-
1902, these same lots of shoats were used in a
on of rice polish with corn meal, both foods be-
lone. The amounts of grain fed to the two lots
ntical.

	Lbs. growth 3 pigs in 4 weeks.	Lbs. grain per lb. of growth.
rn meal	53.5	5.01
e polish	79	3.40

ily rate of growth was much more rapid for the
ng polish and these also required considerably
to make one pound of increase in live weight.

Rice polish versus corn meal in mixed grain ration.

A litter of six Poland China pigs, dropped April 2 1902, were divided into two lots and fed for five week on two lots of grain that were exactly similar excep that rice polish in one was substituted for an equal pe centage of corn meal in the other. The results of th last four weeks of the period follow:

		Lbs. growth.	Lbs. fo per l growt
Lot D	40% corn meal .... 40% cowpea meal .... 20% wheat bran	56	3.7
Lot E	40% rice polish .... 40% cowpea meal .... 20% wheat bran	65.5	3.1

Both of the above mixtures afforded satisfactory rat of growth, but the one containing rice polish was d cidedly more effective than the mixture into which co meal entered.

Rice polish versus corn meal alone, third experimen

This experiment was made with two lots of thr shoats each and extended over eight weeks, terminati October 1, 1902. The shoats used were the same as tho employed in the last mentioned experiment.

	Lbs. growth in 8 weeks.	Total food in 8 weeks.	Lbs fo per l growt
Lot D—Corn meal	68	422.2	6.
Lot E—Rice polish	131.5	492.9	3.

The rate of growth was almost twice as rapid with th pigs fed on polish as for those consuming corn meal.

To make one pound of increase in live weight requir in this experiment 39 per cent. less of polish than corn meal.

Average results with rice polish.

In most of the direct comparisons of rice polish wi corn meal the polish proved decidedly superior.

Taking the average of all five of these direct compa sons we find that to produce one pound of increase live weight of pigs required only 3.73 pounds of ri polish and 4.74 pounds of corn meal. At this rate 78

pounds of rice polish was equal to 100 pounds of corn meal, a saving of 21.4 per cent of the grain by the substitution of polish for corn meal.

The differences in composition are not such as to explain the superiority of the polish, but this may possibly have been partly due to the fact that the rice meal, a flour-like powder, was in a finer state of division than the corn meal.

Composition of rice polish, rice meal and corn meal. Figures from Henry's Feeds and Feeding.

	Nitrogenous Matter.	Starch. etc.	Fiber.	Fat, etc.
Rice polish	11.7	58.0	6.3	7.3
Rice meal	12.0	51.0	5.4	13.1
Rice bran	12.1	49.9	9.5	8.8
Corn meal	9.2	68.7	1.9	3.8

We have had some difficulty in obtaining rice polish from states east of us, it being more profitable for the mills to mix it with other less valuable by-products and to sell the mixture of polish, rice, bran, etc., under the name of rice meal. Rice meal is of variable quality, according to the amounts of each by-product mixed in. Hence the figures quoted above need not be regarded as showing the composition of an average grade of rice meal.

As stated in a previous page we employed in one experiment rice bran mixed with an equal weight of several other foods. We found the rice bran mixtures unpalatable and the growth of pigs fed on it slow. At the South Carolina station rice meal, in connection with large amounts of skim milk, in a brief feeding period produced pork at less cost than when corn meal and skim milk were fed.

In November, 1902, rice meal was quoted to us by Planter's Rice Mills, Savannah, Ga., at $17.90 delivered at Auburn, Ala., in less than carload lots. Rice polish bought from the same firm two years ago cost about $26 per ton delivered at this station. It is of interest to note that a part of this rice polish kept in good condition for more than a year.

According to our experiments rice polish could with great profit be substituted for corn meal selling at the same price.

APPENDIX.

Percentages of internal organs, etc., as affected by food.

	FOOD. 25 per cent cotton seed meal, 75 per cent corn meal.						FOOD. Corn meal alone					
	No. 88.		No. 90, female.		Av. Nos. 88 & 90.		No. 85, female.		Essex Barrow.		Av. Nos. 85 & Essex.	
	Weight lbs.	% in terms of live weight.	Weight lbs.	% in terms of live weight.	Weight lbs.	% in terms of live weight.	Weight lbs.	% in terms of live weight.	Weight lbs.	% in terms of live weight.	Weight lbs.	% in terms of live wght.
Date of butchering	Nov. 16.		Nov. 16.				Nov. 20.		Nov. 16			
Live weight	127	......	117 00	......	122	......	135	......	127.00	......	131.00	......
Blood	......	......	2.00	1 71	.....	......	3	2 22	3 00	2 36	3.00	2 29
Dressed carcass, including head & feet.	103 5	81.4	93 00	79 5	98 3	80.55	111.5	82.65	96 40	76 10	103 95	79 37
Lungs	.52	.41	49	.42	.51	.42	73	.50	.60	47	.66	49
Liver	1 80	1.42	1.60	1 37	1.70	1.40	1 91	1.41	3 10	2 44	2 50	1.92
Heart	29	.23	.26	.22	.28	.23	.26	.19	.24	.19	.25	.19
Kidneys	.38	.30	46	.40	.42	.35	.35	.26	.33	.26	34	26
Spleen	.09	07	.10	.09	10	.08	12	.09	.12	.09	.12	09

The most significant differences attributable to the foods is the greater weight of kidneys and heart of the pigs receiving the more nitrogenous ration, and the greater weight of lungs (as in our former experiments) when the ration was highly carbonaceous.

N No. 123. APRIL, 1903

ALABAMA.

cultural Experiment Station

OF THE

ICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Cowpea, and Soy Bean Hay as Substitutes for Wheat Bran.

By J. F. DUGGAR.

BROWN PRINTING CO., PRINTERS & BINDERS
MONTGOMERY, ALA.
1903.

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*On leave of absence.

The Bulletins of this Station will be sent free to any citi the State on application to the Agricultural Experiment S Auburn, Alabama.

HORTICULTURAL LAW AND RULES
ED BY THE BOARD OF HORTICULTURE.

INTRODUCTION.

ars the horticultural interests in Alabama have very much from the injury done by various in- fungous pests. Most of the seriously injurious distributed upon nursery stock from infested The nursery trade is a legitimate one, and should be encouraged when honestly conducted. introduction of the notorious San José scale e have awakened to the fact that it is nec- o protect the planter from stock from in- rseries. The method commonly adopted is to nursery stock infested with pests, as danger- e public welfare, and order such stock de- To do this all nurseries have to be examined ore times each year, to see if there are no pests ock growing therein. If all the stock is healthy ate of health is given, stating that the stock is ly free from all such pests. Even with all this n the planter should ever be on the lookout for nd fungous pests which may have escaped the inspector, or which may have gotten upon the plants after the time he made the examination. any wide-awake fruit growers of Alabama have been trying to get adequate laws to aid them in g the industry in this State. This past winter y-organized State Horticultural Society took r up, and with the aid of others interested in , succeeded in getting the Legislature to pass ving law:

No. 121. Code of 1903.

AN ACT

To Further Protect Horticulture, Fruit Growing,
.Truck Gardening, and to Exclude Crop Pests o
Kinds in the State of Alabama.

SECTION 1.—*Be it Enacted by the Legislature of*
bama. That from and after the passage of this act,
Commissioner of Agriculture and Industries of the S
of Alabama, the President of the Alabama State H
cultural Society, and the Director of the Experin
Station of the Alabama Polytechnic Institute shall
officio, constitute a board to be known as the S
Board of Horticulture, of which the Commissione
Agriculture and Industries shall be chairman, w
board shall have full power to enact such rules and r
lations governing the examination, certification,
transportation and introduction of trees, shrubs,
tings, buds, vines, bulbs, and roots, that they may d
necessary to prevent the further introduction, incr
and dissemination of insect pests and plant diseases.

SEC. 2.—That the Professor of Horticulture of
Alabama Polytechnic Institute shall act as State H
culturist and as secretary of said Board of Horticul
under the provisions of this act, and it shall be the
of the said board to promulgate rules and regulatior
accordance with this act for the government of the
State Horticulturist in the duties devolving upon hi
execution of the provisions of this act.

SEC. 3.—There is hereby annually appropriated
sum of ($1,500) fifteen hundred dollars, to be disbu
under the direction of the Board of Trustees of the
bama Polytechnic Institute for the purpose of defra
the expense in the execution of this act.

SEC. 4.—The State Horticulturist or a deputy

d by the Board of Horticulture, shall have
nder the regulations of the Board of Horticul-
sit any section of the State where such pests are
to exist, and to determine whether any infested
lants are worthy of remedial treatment or shall
yed, and he shall immediately report his find-
riting, giving reasons therefor, to the owner of
ed plantation, his agents or tenant, and a copy
eport shall also be submitted to the said board.
f objections to the findings of the State Horti-
or his deputy, an appeal shall be made to the
rd, who shall have power to summon witnesses
testimony on oath, and whose decision shall be
n appeal shall be taken within ten days and
as a stay of proceedings until it is heard and

—Upon the findings of the State Horticul-
his deputy in any case of infested trees or
e treatment prescribed by him shall be exe-
nce (unless an appeal is taken), under his sup-
the cost of material and labor shall be borne by
r; provided, however, that in case the trees or
all be condemned they shall be destroyed by the
rticulturist, and the expense of such action
orne by the owner. No compensation shall be
or any plants that shall be destroyed.

.—In case any person or persons refuse to
he direction of the State Horticulturist or of
Board upon an appeal, a Justice of the Peace or
Judge of the county shall, upon complaint filed
ate Horticulturist or any freeholder, cite the
persons to appear before him within ten days
ce being served, and that the said judge upon
ry evidence shall cause the prescribed treat-
e executed, and the expense thereof and cost of

court shall be collected from the owner or owners of
fested plants.

Sec. 7.—It shall be unlawful to offer for sale,
give away or transport perenial plants, scions, b
trees, shrubs, vines, or other plants, tubers, roots,
tings, bulbs, known to be infested with dangerously
jurious insects or plant diseases. Any person or pers
violating this section shall, upon conviction, be fined
less than ten nor more than one hundred dollars for e
separate offense.

Sec. 8.—The said Board of Horticulture, its age
or employes, are hereby empowered with authority
enter upon any premises in discharge of the duties h
in described. Any person or persons who shall obst
or hinder them or their agents in the discharge of t
duties shall be deemed guilty of a misdemeanor, a
upon conviction therefor, shall be fined not less than
nor more than one hundred dollars.

Sec. 9.—The Board shall have the power also
adopt rules and regulations, not inconsistent with
laws and constitution of this State and the Uni
States, for preventing the introduction of dangerou
injurious crop pests of all kinds from without the St
or regarding the dissemination of crop pests within
State, and for the governing of common carriers in tr
porting plants liable to harbor such pests, to and fr
and within the State, and such regulations shall have
force of laws.

Sec. 10.—Be it further enacted, that the members
said Board, any two of whom shall constitute a quor
in the absence of the third, shall, within thirty days
the passage of this act, and from time to time, draw
and promulgate through the press of the State the ru
and regulations necessary to carry into full and c
plete effect the provisions of this act, carefully defin

eases or maladies, both insect and fungus, shall
e infectation in trees or plants, within the
and purview thereof.
.—It shall be unlawful for any person, firm or
on to sell, give away, or ship within the State
na any trees or shrubs or any other plants com-
own as nursery stock, without having a certifi-
arantee of the State Horticulturist of Alabama.
f such certificate of guarantee must accompany
or package sold, given away or shipped. Such
e must be dated within twelve months. If upon
ion such stock is found to conform to the re-
ts of the said Board of Horticulture, the State
turist must furnish a certificate to that effect.
on or persons selling, giving away or shipping
tock without the certificate of the State Horti-
shall be fined not less than fifty nor more than
red dollars.
.—Each and every person, firm or corporation
and doing business outside of the State of Ala-
ling in or handling trees, shrubs or other plants
y known as nursery stock, shall file a copy of
certificate of his or its inspection furnished by
Horticulturist, nursery inspector or other duly
d official of his or its State or county with the
of the Board of Horticulture. Upon the filing
rtificate as above prescribed, and upon request
son, firm or corporation, a certificate will be is-
he same, and official tags bearing copy of such
e and seal of the Board will be furnished the
ost, provided, however, that the aforesaid certi-
nspection shall be adjudged satisfactory by the
Each box, bundle or package of nursery stock
nto Alabama by any person, firm or corporation
r one of these tags, and shipments of stock not

thus tagged shall be liable to confiscation by the B
of Horticulture through its agents or employes.

SEC. 13.—No transportation company or common
rier shall deliver any box, bundle or package of t
shrubs or plants commonly known as nursery stoc
any consignee residing within the State of Alab
when said box, bundle or package does not bear the
cial tag or certificate of guarantee issued by the S
Horticulturist without previously notifying the S
Horticulturist of the particulars of the shipment as
may be required by the Board, nor without duly w
ing the consignee of his risk in accepting said shipm
Failure on the part of any transportation compan
common carrier to conform to these requirements s
be deemed a misdemeanor, and shall be punishabl
each instance by a fine of not less than ten nor more t
fifty dollars. Provided, that no common carrier shal
liable for damages to the consignee or consignor fo
fusing to receive, transport, or deliver such trees, p
ages, or boxes, when not accompanied by the tag or
tificate herein provided.

SEC. 14.—Any person, firm or corporation recei
from any other firm, or corporation, any box, bundl
package of trees, shrubs, or plants commonly know
nursery stock, which is not accompanied by a certifi
of guarantee, or official tag issued by the State Horti
turist to cover said stock, shall be deemed guilty
misdemeanor, and, upon conviction, shall be fined
less than ten nor more than one hundred dollars.

SEC. 15.—It shall be the duty of the State Horticul
ist to make a quarterly report of his work, and of the
penditures under this act to the Board of Horticult
and said Board shall report annually to the Governo
the State.

Approved March 5, 1903.

Official: J. THOS. HEFLIN,
Secretary of Stat

THE BOARD OF HORTICULTURE.

s provided by the above law the following persons ex-officio members of the Board of Horticulture:

he Commissioner of Agriculture and Industries, irman.

he Hon. R. R. Poole, Montgomery.

he President of the Alabama State Horticultural So- ',

r. W. F. Heikes, Huntsville.

he Director of the Experiment Station, Alabama technic Institute,

rof. Chas. C. Thach, Auburn.

he Professor of Horticulture of the Alabama Poly- nic Institute, to be State Horticulturist and Secre- to the Board.

rof. R. S. Mackintosh, Auburn.

he Board of Horticulture met at Auburn, March 20, , and in accordance with Section 10 of the above the following insects and fungous diseases were con- ed dangerous and to constitute infestation in trees plants:

) San Jose Scale, (*Aspidiotus perniciosus.*)

) The New Peach Scale, (*Diaspis amygdali.*)

hen found in a nursery all infested stock to be ed. If San José Scale is found in the immediate hborhood, all stock must be fumigated or certificate be withheld.

) Black Knot, (*Plowrightia morbosa.*)

) Crown Gall, (*Dendrophagus globosus.*)

hen found in a nursery all diseased stock to be de- ed, otherwise stock may be shipped.

) Peach Yellows.

) Peach and Plum Rosette.

l infested trees and nursery stock to be destroyed.

(7) Woolly Aphis, (*Schizoneura lanigera.*)

All badly diseased stock to be destroyed. Other s to be fumigated or treated with kerosene emulsion.

RULES.

The following rules and regulations were adopte

Rule 1.—The State Horticulturist is hereby cha with the enforcement of this act, and is directed to l by personal visits, by correspondence or in such manner as he may deem best, to locate the above na pests, so far as they exist in this State, and to take action, in accordance with the above act, as he may necessary to control or eradicate the same.

Rule 2.—The State Horticulturist shall have pow require all nursery stock sold within the State of bama to be treated with hydrocyanic acid gas, wh his judgment the presence of any pest requires it, fo better protection of the interests of the citizens o State. Upon the failure of any individual, firm or poration to comply with this, the State Horticultur hereby authorized to withhold his certificate.

Rule 3.—All certificates of examination shall e prior to July 15th of the year after date of issue.

Rule 4.—All nurseries are to be examined bet July 15th and November 15th of each year.

Rule 5.—Definition of Nursery Stock.—In additi fruit trees, the following if offered for sale are cl as nursery stock, and are subject to the regulations erning the examination and transportation of the s Strawberry plants, vines, ornamental trees and shr (Including field grown roses.)

Rule 6.—All appeals from the decisions of the Horticulturist should be addressed to the Chairm the Board of Horticulture, at the Capitol, Montgo Ala.

ıle 7.—All communications relative to the examin-
ı of orchards and nurseries should be addressed to
State Horticulturist, Auburn, Ala.
ıle 8.—A deputy duly authorized by the Board of
iculture shall have the same power and authority
ıe State Horticulturist in carrying out the provis-
of this act under the direction of the State Horti-
ırist.

is not the intention of the Board nor the State
iculturist to cut down and destroy orchards unless
ease absolutely demands it, but rather to use some
dial treatment if possible. It will be the aim to see
the nursery stock sold in this State is free, or sup-
l to be free, from all seriously injurious pests. To
this law most effective everyone interested should
carry out the provisions of the law and to report
ptly all cases of the violation of the law by any one.
e purchasers of nursery stock are requested to read
on 14, of the law, which makes it a misdemeanor for
to receive any nursery stock not provided with a
ficate or official tag authorized by the State Horti-
ırist to cover such stock.

NOTES ON SOME OF THE INSECTS AND FUNG DISEASES AFFECTING HORTICULTURAL CROPS.

Only the insects and fungous diseases enumerate the Board of Horticulture, as very dangerous pests here described, and while they do not represent all that injure our horticultural crops, yet, they do r sent the more dangerous ones.

The good old adage "an ounce of prevention is w a pound of cure" must be our motto, for, in fact, the foundation on which our Horticultural Law is *i. e.*, to examine all nursery stock so as to keep ou various insects and fungous pests.

Unfortunately the San Jose scale is found in parts of Alabama. It was brought here on nursery from infested localities, and there is no hope of ent ridding our state of this scale, but with the earne forts of the various growers, we should be able to it from spreading farther.

The State Horticulturist is ready to do all he ca help in preventing the spread of the various pest nursery stock, and to aid the owners of infested ards to rid their premises of them.

Recommendations.—The best, as well as the practical way of treating nursery stock, is to fum it with hydrocyanic acid gas. This is usually dor the nurseryman before the stock is packed for shipr It should not be considered as an entirely safe ren but, rather, as one of the safeguards to use in secu clean stock. All growers should be continually or watch for the first indication of any trouble foreig the natural growth or habit of plant or tree.

After the trees have been pruned and ready t planted, they may be dipped in the lime, sulphur salt solution for a moment. This covers the trunk branches with this insecticide, and should destroy of the living scales.

Caution—In doing this only dip the top, do not submerg roots, and do not treat at all when the buds have started. gation or dipping can only be done when the trees are dorm never after growth has started.

With one or both of these precautions, and then only
etting the stock from regularly inspected nurseries,
ould practically guarantee trees free of any of the
ove named pests.

Orchard treatment.—When the scale is discovered in
 orchard, all badly infested trees should be dug up and
rned. These trees will be killed in a comparatively
ort time, from the injury caused by the scale, and be-
des, the owner is free from this source of infection. In
e end it is a saving rather than a loss.

Undoubtedly the best remedy that we now have is the
me, sulphur and salt wash. This has been tried in a
eat many places, and has been found very success-
l in controlling scale insects. While it cannot be ex-
cted to kill all the scales at once, yet it kills the larger
art of them, and helps to successfully keep them under
ntrol. To be effective the lime, sulphur and salt wash
ust be carefully made, and in spraying every part of
e tree, from the ground up, must be covered. It is
lvisable to go over the trees a second time in order to
ver parts overlooked the first time.

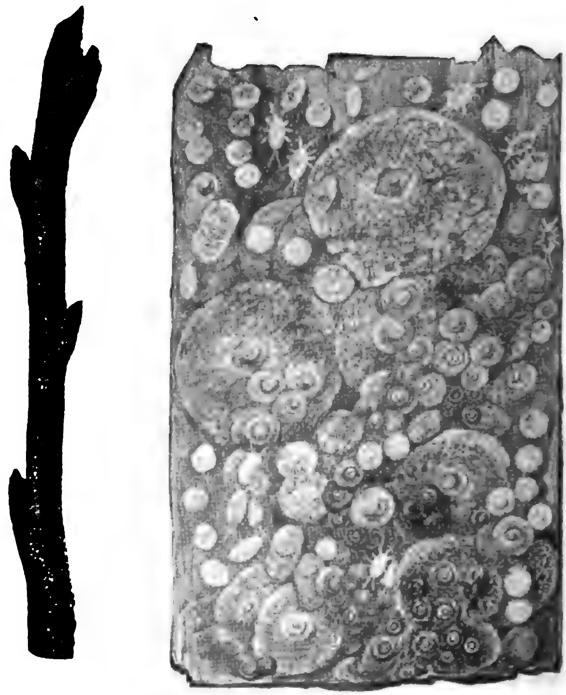
Spraying at best is laborious and disagreeable work,
d unless done thoroughly and at the proper time, is
ttle better than if not done at all. This wash can only
 applied to the trees in winter time, as then the trees
re dormant. It seems that the best time to apply it is
st before the buds open in the spring.

So far no successful summer treatment has been found.
s mentioned above, all badly infested trees should be de-
troyed and all others not so badly infested should be
eated by covering the trunk and larger branches with
e lime, sulphur and salt wash. Use one-half the regu-
r strength, and apply by either a brush or spray
ump. Be careful not to get too much on the foliage,
lthough it is better to sacrifice some of the foliage
ather than not to touch the larger part of the scales.

Spraying Outfits.—Too much can not be said in favor
f having strong and effective spraying outfits. A small
aky pump, with only a few feet of hose, and a wornout
ozzle are not the proper things to use in spraying trees.
t is much better for several congenial growers to unite
 purchasing a good, serviceable outfit, rather than for
ach to purchase smaller and less efficient apparatus.

The San Jose Scale, (*Aspidiotus perniciosu*

Comstock.



a *b*

Fig. 1.—Appearance of scale on bark: *a*, infested twig, 1
size; *b*, bark as it appears under hand lense, showing sc
various stages of development, and young larvae. (Howa
Marlatt, Bul. No. 3, New Series, Div. of Entomology, U. S. D
Agr.)

How to detect it.—This scale is very small and
rather difficult for an inexperienced eye to dete
Roughly speaking, it is about the size of a pinhead.

The description of the San Jose scale; New Peach scale;
Knot; Peach Yellows and the Peach and Plum Rosette are b
W. M. Scott, State Entomologist of Georgia; and those
Woolly Aphis and Crown Gall are by Prof. S. A. Forbes
Entomologist of Illinois.

hand lense the female is dark gray in color, cir-
d conical in outline, and terminates at the cen-
nipple like prominence, surrounded by a dis-
g. The male scales are elongated and smaller,
nipple near the anterior end. The real insect
the scaly covering is plump, circular in outline
owish. If crushed with the point of a knife the
a pale yellowish liquid. The newly-born young
minute mite-like creatures, long oval in shape,
e orange color. They are quite active in seeking
le spot on which to settle, and in a few hours
e anchored themselves with their beak for life;
n the case of the males, which issue at maturity
ngs, and become active again.

a tree becomes crusted over with these scales
has the grayish appearance of having been
ver with dampened ashes.

Plants.—The San Jose scale may be looked for
e following plants: Peach, plum, apple, pear,
cherry, quince, almonds, rose, Hawthorn, rasp-
piraea, cotoneaster, prunus pissardii, straw-
owering quince, mountain ash, gooseberry,
flowering currant, grape, English walnut, pe-
ck walnut, persimmon, elm, osage orange, lin-
nymus, weeping willow, Kilmornock willow,
willow, golden willow, cotton-wood, Lombardy
Carolina poplar, catalpa, sumach, silver maple,
haps some others.

nent.—For nursery stock, fumigation with
anic acid gas in an air-tight room is the only
edy; and, in fact, this treatment cannot be con-
an absolute surety against the scale, since some
n opening in the house may allow the gas to es-
fore it has done its deadly work. Where trees
ally known to be infested they should never be
t should be burned. There is too great a risk
se of infested stock, no matter to what treat-
may have been subjected. Fumigation is a good
on, and every nurseryman should fumigate his
ot only on account of the probable existence of
his nursery, but also on account of other insects
usually present on nursery trees to a greater or
ent. This work of fumigation is accomplished

by packing the trees in a *air-tight* room and subjec them to the fumes of hydrocyanic acid for thirty minutes. The gas is generated by treating chemic pure potassium cyanide with the best grade of com cial sulphuric acid at the rate of 1¼ oz. of cyanide oz. of acid and 5 oz. of water to every 150 feet of c space in the room.

PRELIMINARY TREATMENT.

Unfortunately there seems to be no satisfactory mer treatment for the San Jose scale, and winter a cations must be chiefly depended upon for the contr this pest. However, it is not infrequent that sum spraying can be done to advantage. This insect plies at a rapidly increasing ratio during the bree season until checked by cold weather about the mi of November or later. In this climate, therefore, period of greatest reproduction among the scale ins and consequently of greatest damage to the infe trees, is from about the middle of September to the dle of November. Trees that are only slightly infe in July may become encrusted with scales by Noven Frequently this rapid fall multiplication of the s if left unchecked, results in the death of a great n trees before a winter wash can be applied.

The value of late summer or fall spraying in chec the progress of the scale has been determined not by our experiments, but also by practical work in l orchards. A 10 per cent. strength (or even 15 per when carefully used) of kerosene or crude oil ap in mechanical mixture with water, or in soap emul does not materially damage peach trees in foliage does destroy large numbers of scale insects, espec the recently issued young and a considerable per cen the breeding females. During the breeding season progress of the scale should be watched, and if it th ens to kill or impair the infested trees before wi sets in, two or three applications of oil should be m These may be made at intervals of two or three w as occasion seems to demand, but even two applicat on successive days or with one day intervening, are siderably more effective than a single one. The tr and larger limbs should be thoroughly sprayed,

renching of the foliage should be avoided as much as ossible. The oil has a tendency to scorch the foliage, ut not to a serious extent if the work is properly done.

IOW TO PREPARE THE SPRAYING MATERIALS.

KEROSENE OIL EMULSION.

Formula and Directions.—An emulsion of either crude etroleum or kerosene may be made from the following ormula:

2 pounds potash whale-oil soap.
4 gallons water.
8 gallons oil.

Weigh the soap carefully and place with the water in vessel over the fire, using a slight excess of water to ıake up for evaporation. Fit a pump with a short piece f hose, to which is attached a nozzle for throwing a raight stream 3-16 or 1-4 inch in diameter. Pour the il into the barrel or tub in which the pump is set, and hen the whale-oil soap is dissolved, and the solution beins to boil, add it to the oil, and pump the whole vigorusly back into itself for a period of at least ten minutes. he stream from the nozzle should be directed straight ownward into the mixture so as to stir it to the very ottom. After a few minutes the oil and soap solution ill be seen to combine, forming a thick, creamy emulon, which when perfectly made will remain without ıange for weeks.

For a 20 per cent. strength add water to make 40 galns.

For a 15 per cent. strength add water to make 53 1-3 allons.

For a 10 per cent. strength add water to make 80 galns.

Materials and Pump Required.—Either crude oil or erosene will give good results in making emulsion. The oap should preferably be some soft whale-oil soap, such s Good's No. 3. If a hard soap is used the emulsion ill be curdy, and only with difficulty mix with water.

The ordinary Bordeaux spray pump answers very well or mixing the emulsion, but almost any pump will do ozzle A "Bordeaux" or "Seneca" nozzle gives a very hat can be fitted with the requisite section of hose and

satisfactory sized stream for this work, though rat
small.

The water used must be soft, for if hard no stab
emulsion can be prepared, and it sometimes happens t
foreign substances chancing to be present, will prev
the emulsification. In case limestone or hard wate
to be employed, it should be broken by the addition o
small quantity of lye. If a lot of soap solution and
for any reason, fails to emulsify properly, the best th
to do is to throw the whole away, carefully clean up
pump, wash out all the vessels used and begin over.

Properties of the Emulsion.—The emulsion, if w
made of the proper soap, will retain its creamy con
tency when cold, and is easily mixed with water in
proportions. No alarm should be felt if a small port
of the soap and water fails to emulsify, and separate
the bottom, nor, if after being exposed to the air for so
time, a thin scum forms over the surface. If on l
standing globules of free oil rise to the surface, or i
thin ring of oil collects around the sides of the conta
ing vessel, the emulsion should either be thrown aw
or warmed up and agitated afresh.

When diluted the emulsion may slowly rise,
cream, to the surface, and in order to prevent this
spray pump in which it is to be used should be provi
with an agitator.

Never try to boil the kerosene over the fire; it is
necessary, and besides it is very dangerous.

THE LIME, SULPHUR AND SALT WASH.

FORMULA AND DIRECTIONS.

This wash may be prepared by combining lime,
phur and salt in several different proportions, but
following appears to be the generally accepted formu

Quick lime	30 pour
Salt	15 pour
Flower of sulphur	20 pour

Water to make 60 gallons.

Slake half the lime carefully and place it in a la
kettle with 25 gallons of water; grind the sulphur
with a little water, breaking the lumps as fine as
sible by passing through a seive and add to the lime; b

s it boils the liquid will gradually become thinner and
inner, the lime and sulphur dissolving simultaneously
form a deep orange-red solution. When the sulphur
s apparently all entered into solution, which may
ke two hours or more, slake the remainder of the lime,
d to it the salt, and pour the two into the lime and
lphur solution. Boil the whole for from half an hour
an hour longer, strain, and dilute with warm water
60 gallons. Do not let it become thoroughly cold, but
ray while yet warm.

The principal care in making up this wash is to make
re that the sulphur is thoroughly dissolved. Flowers
sulphur is apt to be more or less lumpy, and these
mps are very difficult of solution. The more thor-
ghly the sulphur is ground up with water before be-
g boiled with the lime, the less time it will take in the
iling.

An iron kettle must be used if the boiling is done di-
ctly over a fire. A better and cheaper way, whenever
head of steam is available, is to place the sulphur, lime
d salt together in a barrel half full of water, conduct
e steam through a pipe to the bottom of the barrel and
il it for two or three hours, with occasional stirring,
make sure that nothing is settling. If a boiler is con-
nient, a pipe must be so arranged as to conduct steam
a number of barrels at once.

NEW PEACH SCALE. (*Diaspis amygdali* Tryon.)

How to detect it.—This scale is readily distinguished
om the San José scale in that the female is a little
rger, of a lighter gray color, with the elongated ex-
ial point ridged and located at one side of the center,
d the male is smaller, elongated, with parallel sides
d white. The excuvial point is similar to that of the
male, but located at the anterior end. A tree badly
fested has a white-washed appearance from the color
the male scales. Where only females occur, however,
grayish brown appearance is produced.

It is the habit of these insects to cluster about the
unk and the lower parts of the larger limbs of a tree.

The original home of this insect is probably either
e West Indies or Japan. From its probable West In-

dian origin it gets one of its popular names, "West
dia" scale.

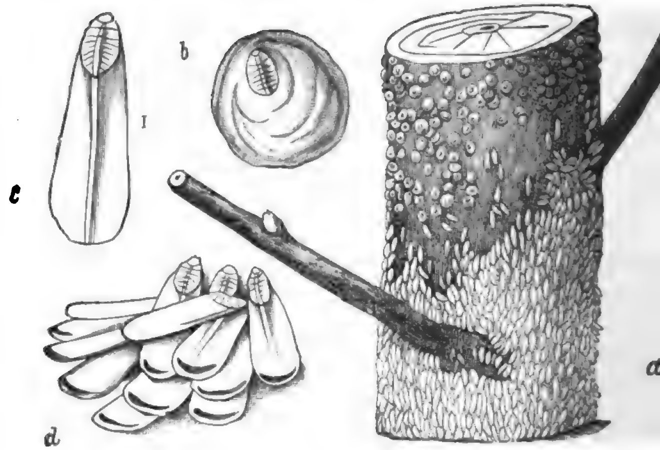


Fig. 2.—The New Peach Scale: a, branch covered with mal
female scales, natural size; b, female scale; c, male scale; d,
of male scales—enlarged. (Howard, U. S. Dept. of Agr., Year
1894.)

It attacks the peach, plum, apricot, cherry,
grape, persimmon, and a few other plants.

Treatment.—The winter treatment for this inse
about the same as that for the San José scale. Th
male pass the winter in the mature and partially ma
state, and can be killed by the lime, sul
and salt wash, or by the whale-oil soap t
ment at the rate of one pound dissolved in one
lon of water. In Georgia there are three or four br
from eggs, which appear at more or less regular i
vals, the first appearing about the middle of Marc
the season is favorable. These broods should be wat
for and ten per cent. kerosene or whale-oil soap at
rate of one pound to four gallons of water should
applied at the time of their appearance.

It is becoming one of the most dangerous pests

hich we have to contend, perhaps equal to the San José ale. Th most vigorous measures should be adopted for s eradication while it is yet in its incipiency.

BLACK KNOT. (*Plowrightia morbosa* Sch.)

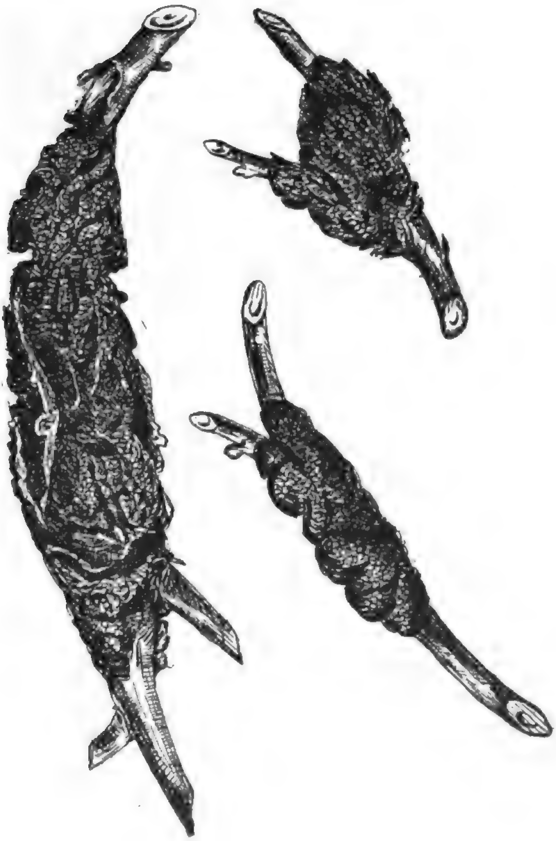


Fig. 3.—Black Knot.—Old knots on cherry twigs, natural size. cott, Bul. No. 1, Georgia State Board of Entomology.)

Plums and cherries are subject to the attacks of a dis- se very expressively termed "Black Knot." This dis-

ease is American in its origin and occurs more or abundantly throughout the United States, but i pecially prèvalent in the Eastern States, where it s to have first appeared. In some sections of the growers of plums and cherries have been forced time to time to abandon the industry in consequen the ruinous effects of its work. Cases are on re showing that orchards that paid handsomely one were completely destroyed the following year or tw

The more intelligent growers are fully aware of injuries they are liable to suffer from its attacks, whenever it appears on their premises they lose no in removing it by cutting off affected parts or roo up the diseased trees. Through such wise measures disease has not been allowed to get beyond contro

How to detect it.—Some fully formed knots are i trated in figure 3. These are large, rough, black cresences, due to the growth of a fungus (*Plowrig morbosa*) in the cambium layer of the branches or t These crusty enlargements may extend entirely aro the branch or grow lengthwise on one side. The swelling usually begins in the spring, when the sap gins to flow; it may, however, occasionally be not in the fall. Th first indication is a slight enlargem usually longitudinal, which rapidly increases in as the season advances. The bark is soon ruptured finally scaled off, exposing a yellowish brown cr surface. In May the fungus bears a crop of infec spores on the surface of the knot, which gives it a vety appearance. These spores are soon scattered the wind or other natural agencies furnishing infec for other trees and thus disseminating the disease. knot then becomes hard and black as fall is approac

It has not yet completed its work. During mid-winter another crop of spores is produced and scattered. These gain lodgment in the cracks and crevices of the bark and in the forks of twigs and at the growing points, ready to germinate and penetrate the tissues of the bark as spring opens up.

Treatment.—The most effective method of controlling this disease is to cut out all the knots as soon as they appear and burn them. This work should be supplemented by spraying with Bordeaux (four pounds of copper sulphate and five pounds of fresh lime to fifty gallons of water). Four applications are necessary, two for the winter crop of spores and two for the summer crop. The first should be made about two weeks before the buds begin to open, and the second immediately before they open. The third application should be made about the middle of May at the time the summer crop of spores is produced, followed in about two weeks with the fourth.

All wild cherry and plum trees should be carefully watched, as they are frequently badly attacked, and affected parts must be cut away and burned.

THE CROWN GALL. (*Dendrophagus globosus.*)

This is a dark, rough, abruptly protruding tumor growing most commonly from the crown of the tree, and varying in size from that of a pea to that of the fist, or larger—the latter usually on old and long infested trees. A badly affected tree is likely to show signs of starvation, its growth ceasing and its foliage having a sickly yellow look. Young trees often perish from this disease, which is certainly contagious in some forms and perhaps in all, and even large orchard trees may die and finally break off at the base of the trunk.

Although much the most common above the crown, just below the surface of the ground, this gall frequently grows on the larger roots, and is sometimes seen exposed on the trunk. Appearing at first as a simple lump or tubercle, it may so extend its growth as to girdle the trunk with its large wart-like excresences. Young galls while still fresh have at first the color of the roots from which they grow, but later darken from the accumulation of dead bark on their surfaces. They are at first, while very small, softer than the healthy tissue of the root, but harden with age, and their inner structure be-

Fig. 4.—Crown Gall. 1, gall on Mariana Plum cutting; 2, g
at crown and on root of Elberta Peach; 3, gall on Peach indu
by planting diseased Mariana Plum in juxtaposition; 4, gall
duced by innoculation. (Quintance, Report Georgia State Hist
cal Society, 1900.)

irregular and confused. On old galls, soft, white, ng points appear here and there in early spring, enlarging rapidly, become gradually darker and , and by fall take on the appearance of the older 1.

e is much evidence that the crown-gall of the apricot and almond is a contagious disease due inute parasitic organism (*Dendrophagus globosus* y) belonging to a peculiar group of fungi known "slime moulds," but this conclusion has not yet lly verified for the apple, the pear, the respberry, eed, for any other of the numerous kinds of fruit namental trees and shrubs on which similar wart-owths have been observed.

l experimental work now in progress has been car-) far as to warrant conclusions on this point, wn-gall of the apple, now extremenly common in nurseries of the Mississippi valley, can be re-as a suspicious object, and not certainly as a dan-one. But the careful nurseymen, jealous of his s reputation, will not send out even suspected ma-and in doubtful cases will give his customers nefit of the doubt. On this account I strongly ad-at no stock of any kind showing galls of this sort wn, root or trunk should be placed on the . All trees growing in close contact with those fected should have their roots dipped in Bordeaux e as a precautionary disinfectant, and the ground ch the stock so diseased has grown should be tem-y used for some other purpose than that of raising y stock.

CH YELLOWS.

American in its origin, and has been known for one hundred years. It is quite generally distrib-ver the Eastern States north of Tennessee and Carolina. Some of the most important peach sec-f the East have suffered immensely from its de-ve work and in not a few cases entire orchards een completely destroyed. It seems to prefer s, but apricots, almonds, nectarines and Japanese are not free from its attacks.

to detect it.—If the affected trees is in bearing, t symptom is manifested in the premature ripen-the fruit, which may take place several weeks or

only a few days before the normal season of rip
Premature ripening may be due to other causes, b
yellow peaches bear characteristic bright-red, r
blotches over the skin and streaks of red through th
often reaching to the pit. Another reliable sym
is the pushing out of newly formed buds at the e
apparently healthy twigs or water sprouts, into
shoots with small yellowish leaves. Such buds a
not normally put out until the following season.
the disease may cause dormant buds on the trun
larger limbs to push into feeble, often branched s
characterized by narrow stiff leaves. This stage is
tated in figure 5, showing the abnormal growth
tree dying with the yellows. Affected trees may li
three to five years, during which time they are gra
weakened and finally the foliage becomes yellow
reddish in color.

Fig. 5.—Yellows the fourth year. (Smith, Farmers' Bul.
U. S. Dept. Agr.)

The term "yellows" is somewhat misleading. Q
number of supposed cases of yellows in this State
been reported to the writer, but, upon investigatio

llowing of the foliage in every case proved to be due to e peach borers, drouth or some other weakening effect the trees. Premature ripening of the fruit from simir causes has also lead many to believe their trees to affected with the yellows. The absence of red spots the skin and red streaks through the flesh of the fruit ould serve to relieve uneasiness in such cases.

The cause of yellows is yet undetermined, but it is finitely known that it is a disease and can be communicated from tree to tree and from orchard to orchard. xperiments have shown that it can be communicated healthy trees through buds taken from diseased trees, it the manner of its natural spread from tree to tree is t unknown. It is known, however, that from scattered ses in the orchard it will gradually spread over the enre orchard and completely destroy it if left unmolested.

Prevention.—Since yellows is an incurable disease, we n only look to preventive measures for protection.

(1) Peach trees should not be obtained from nursers located immediately in infested sections. Such stock liable to develop yellows after planting out.

(2) Peach pits from affected trees should never be anted. They may reasonably be expected to convey the sease to the young stock.

(3) Whenever the disease appears in an orchard ery affected tree should be rooted up and burned. Simy cutting off affected parts is not sufficient. The virus ists in the apparently healthy parts and would soon velope the symptoms of yellows. The whole tree, root nd branch, must be destroyed.

PEACH AND PLUM ROSETTE.

Similar to the yellows is a disease known as "Rosette" om the peculiar tufts into which the leaf buds grow trees under the influence of the disease. It attacks eaches and plums and is quite generally distributed er the northern portion of Middle Georgia, extending om Augusta to the Alabama line, and from Macon to me distance north of Atlanta. The writer has quite oroughly worked the State over and has never found south of Macon nor in extreme North Georgia. It also ccurs, although to a limited extent, in Eastern Kansas nd in Western South Carolina. It seems to be most

prevalent in Georgia,, where it has been known for
twenty years. It causes the destruction of many
annually in infested sections of this State, but the
ers do not consider it with any great dread from th
that they effectively hold it under control by t
struction of all affected trees as soon as the disea
pears. In some localities, however, rosetted trees
been left in hedges and waste places to propagate th
ease and cause considerable destruction to adjace
chards.

Fig. 6.—Rosette induced in a seeding by innoculation. (
Farmers' Bul. No. 17, U. S. Dept. Agr.)

How to detect it—Figure 6 well illustrates the ap
ance of a tree affected with rosette. This clusteri
gether of the leaves into rosettes usually takes pl
early spring and is one distinguishing character
disease. The foliage assumes a yellowish green or c
color, or, in case of plums, paricularly a beautifu
color. The leaves have a straight, stiff appearance

olled margins. One season is usually sufficient to com-
ely kill the affected tree. In some cases, however,
ree may live two years, especially if it is not at-
ked in all parts at once; but when a tree is once at-
ked it never recovers.

Prevention.—The same preventive measures suggested
yellows apply also to rosette, and particularly should
diseased trees be promptly dug up and burned.
ce rows and hedges where peaches and plums are
wing should be watched and affected trees de-
oyed. By a series of experiments, Dr. Erwin F.
ith,* of the U. S. Department of Agriculture, deter-
ed that it can be communicated by bud inoculation,
eing necessary, however, for the tissues of the bud
stock to unite before inocculation is effected. Fur-
r than this its manner of spread is unknown. Dr.
ith suggests that possibly the disease may enter
ough the roots, but this has not yet been proved. It
ertain, however, that it does spread naturally and
t a few affected trees left standing in an orchard will
time cause the destruction of the entire orchard.
ce the importance of rooting up diseased trees.

HE WOOLLY APHIS. (*Schizoneura lanigera.*)

his insect is especially injurious to young apple trees,
t in the nursery and then in the orchard. It is most
ndant and does its principal damage on the roots of
trees, but spreads also to the bark above ground,
re it is particularly likely to appear on the young
outs which start up from the root of an injured or
ealthy tree. Where abundant it forms bluish-white
tony patches, not unlike some kinds of mould, which,
careful examination, are seen to consist of a crowd or
er of minute sluggish insects, their bodies covered
h a cottony coating which gives the general effect de-
ibed. They are usually most abundant on the roots,
sometimes appear above ground also on the bark of

Farmers' Bulletin, No. 17, U. S. Dept. Agr., page 17.

the trunk or branches. On the exposed parts of the
they are most likely to be noticed about the collar an
the forks of the principal branches, or wherever an
jury to the bark has left a scar. When trees in a
sery or young orchard have a sickly look—the le
dull and yellowish—and are not growing well, the p

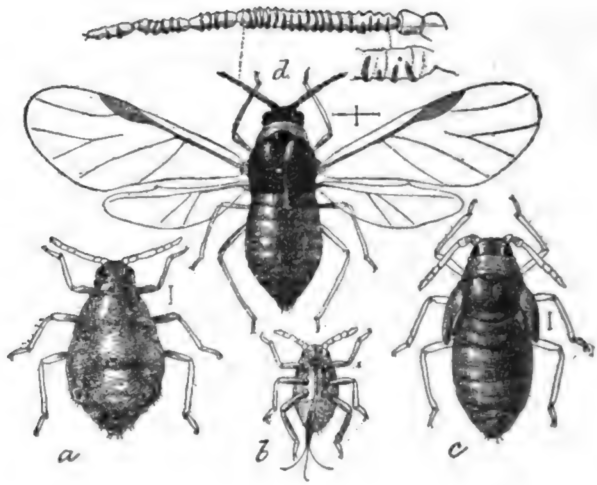
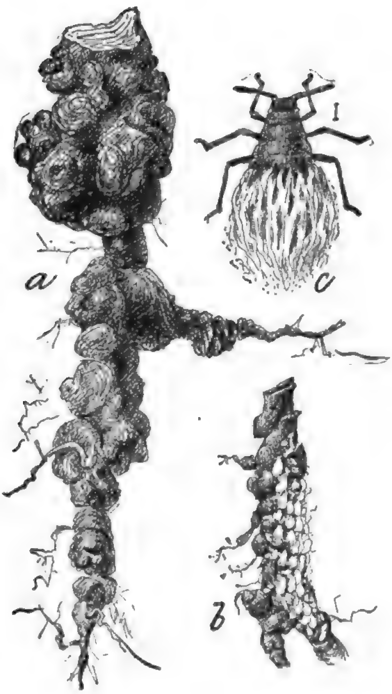


Fig. 7.—Woolly Aphis (*Schizoneura laniger.*)—*a*, Agami
male; *b*, larval house; *c*, pupa; *d*, winged female with antenn
larged above, all greatly enlarged and with waxy excretin rem
(Marlatt, U. S. Dept. Agr.)

ence of this insect on their roots may be suspected
though there may be no appearance of it on the
above ground. If the roots of such an infested tre
examined they will commonly be found distorted an
formed with hard knot-like enlargements, many of t
almost dead, or even in course of decomposi
These gall-like growths occur on roots of
sizes to a depth of a foot or more beneath the sur
Unless the tree is so far gone that the insects hav
serted it, they will commonly be found upon thes
jured roots at all seasons of the year.

The apple is the only tree liable to attack by thi
sect, the current supposition that it may live on
roots of forest trees being an error due to confusio
injury by the woolly aphis with that by the root-rot.

ves under ground at all seasons of the year it comes nfest more or less generally the soil itself, although may be cleared of it by a few months' thorough cul-tion sufficient to destroy effectively all living apple-s. Like many other plant-lice, the woolly aphis mul-ies throughout the greater part of the year by the h of living young from generations of wingless fe-



'ig. 8.—Woolly Aphis (*Schizoneura lanigera.*)—*a*, root of young illustrating deformation; *b*, section of root with aphides clus-l over it; *c*, root louse, female—*a* and *b*, natural size; *c*, much rged. (Marlatt, U. S. Dept. Agr.)

es only, but in October or November winged females ear somewhat abundantly, and, flying freely, espec-y before the wind, distribute the species widely. m these descend in the same autumn a generation nales and females, the latter of which eventually lay h a single winter egg. This is commonly placed hin a crevice of the bark, and, hatching in spring, e rise to a new colony. There may be more or less ration back and forth from the groups above ground

to those on the roots at almost any time of the sum
and fall.

This insect is universally distributed and extre
common, both in orchards and nurseries, becoming
dently more so to the southward. Being highly ir
ious to young trees, it is a difficult pest to deal wit
the nursery trade. It probably cannot be wholly e
icated from an infested nursery, and, perhaps, can n
be completely and permanently kept out of a new p
tation. Fortunately, trees a few years old, once
established, commonly suffer but little from its p
ence, and our preventive and remedial measures r
consequently be directed to the preservation of yo
stock. No tree whose roots are visibly injured by
woolly aphis should be allowed to go from the nurs
and none in the least infested by it should be sent
until the roots have been freed from it by insecticide
plication.

The simplest method of destruction of the aphis on
roots is dipping for a few seconds in water kept he
to 130-150 deg. Fahr. Where heat cannot be convenie
maintained, kerosene emulsion, diluted to contain al
ten per cent. of kerosene, may be substituted. In
nursery, seedlings or graftings may be protected by u
tobacco dust freely in the trenches in which they
planted, or by sprinkling together dust in a shallow
row along each side of the nursery row as closely to
tree, and afterwards covering loosely with earth.
fested trees should not be sent out from the nur
except after fumigation with hydrocyanic acid ga
after dipping the roots in hot water or in kerosene e
sion. Trees with aphis galls or knots should neve
sold, but thrown out and burned. Trees which l
been growing longest in the nursery are usually the w
infested. Culls kept from year to year, apt to be r
nurseries for the multiplication of these and other
structive pests. In preserving overgrown trees in l
of making a cheap sale, the nurseryman usually "s
the penny and loses the pound."

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ALABAMA.

ricultural Experiment Station

OF THE

GRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Some Diseases of Cattle.

By C. A. CARY
and
F. G. MATTHEWS.

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The Bulletins of this Station will be sent free to any citize the State on application to the Agricultural Experiment Sta Auburn, Alabama.

CONTENTS.

PART I.

BY C. A. CARY.

COW POX. VARIOLA.

COW POX is a skin disease naturally occurring i
and rarely appearing in other cattle. It may be
mitted by inoculation to calves and to man. Th
nature of the virus has never been discovered: v
kinds of bacteria have been reported as the caus
some investigators claim that it is produced by a
mal micro-parasite.

The period of incubation is said to be from t
four days. The eruption occur usually on the tea
udder and neighboring parts; some observers
eruptions on the inside of the thighs, on the hea
on the scrotum and perineum of the bull.

The teats at first become slightly swollen, se
and somewhat hard; in a short time appear a num
pimple-like modules, having hard or tumified bas
the teats and udder around the base of the teat
transparent skin these modules are scarlet red o
red; on white skin they are bluish white, giving a f
cent reflection; on a dark skin the nodules have a
gray color; and, if the skin is thick and tough th
ples may be a dirty yellowish gray in color. The pi
or nodules are enlarged popillæ of the skin and v
size, yet they average about one-fourth of an i
diameter. In about two days the outer layer of th
is raised, around the center of the enlarged pim
viscid, yellowish lymph, which is in separate sa
(multilocular vesicles); by thus raising the out
ders of the nodule its center appears depressed. I

me nodules the excess of lymph raises the entire outer ver of skin over the nodule, forming one large unicel- ar vesicle, filled with thick, yellowish lymph (serum). e vesicles usually become mature in 8 to 10 days, and ry in size from one-fourth to three-fourths of an inch diameter; they are usually circular on the udder and y be elliptical on the teats. When the vesicles are not oken their contents become purulent (filled with pus), centre first becomes brown in color which soon ex- ds to the border of the pustule. The pustule dries d a dark brown scab or crust is formed which usually ops off about the fourteenth day, leaving a pale red white and shining, depressed scar. The vesicles or stules on the teats are always broken by the milker and brown scabs come off prematurely and sometimes op into the milk to be removed from it by the strainer. mplete recovery takes place in the eruptions that ap- ar on the udder in about 21 days; but with those on the ts successive scabs or crusts are removed, ulcers be- me "cracked" and raw, and healing occurs slowly, re- iring in some instances thirty to forty days. During s time re-infection or infection with pus germs may e place and thus successive crops of nodules (pos- ly vesicles and pustules) and scabs may appear. In case under my direct observation there were four cessive crops of eruptions in four months (winter and ing) on the teats and udder of the same cow. Crusts m the third crop were mixed with dilute glycerine and alf was inoculated, by vaccination, producing an ulcer h a scab or crust without apparently passing through icular and pustular stages. Had I used the crusts m the first crop I am confident true cow pox would e been produced in the calf. Moreover, the calf inocu- ed had been getting the milk from this cow (not king) and may have become immune before being in- lated.

Dr. Van Es, while practicing in Mobile, reported t
a case where a milker became infected on the har
milking cows with cow pox.

Owing to the fact that man is inoculated (vaccina
with bovine virus (cow pox virus) to produce a pa
immunity to small pox, it is possible that many cows
become inoculated by milkers who scratch their
cinated arms and fail to disinfect their finger nails b
milking the cows. Records (Crookshank and otl
seem to indicate that cow pox is usually more prev
when small pox scares are numerous, and many pe
are vaccinated; this relationship appears to be tr
far as the imperfect records of cow pox in Alabama
indicate. I have observed that children who drink
milk sometimes have ulcers not unlike vaccinatio
cers, about the mouth or face or on the hands; this r
result from scratching pimples, eroded places or
when the finger nails are covered with infected mil

The fact that milkers, who become infected with
pox, were partly or wholly immune to small pox, le
celebrated Jenner to discover and apply the meth
vaccinating man with cow pox virus in order to pr
virulent small pox.

The virus of cow pox is fixed and can only be t
mitted by direct inoculation. Generally the milker
ries it from one cow to another and, if not immune,
ulates himself, or carries it from his vaccinated arm
susceptible cow. One attack, or series of eruptions
duces immunity in a cow for life. Hence young co
first period of lactation (with first calf) are the
most frequently infected; yet older cows may have
not already immune. It is generally more virule
winter than in summer.

The chief troubles resulting from cow pox are th
noyance or difficulty in milking and sometimes a dec

ow of milk; the latter may be due to lack of removing l the milk; also "caked bag" or mammitis may be a quel to lack of removing all the milk. Moreover, there some danger to non-immune milkers and possibly to on-vaccinated children.

Treatment consists in isolating the affected cows and lowing the same milker to milk the diseased cows and others. The milker should keep his finger nails cut ose and smooth and thoroughly wash and disinfect his nds after and before milking with a 2 per cent. solution creolin, or corrosive sublimate 1 part and water 1,000 rts.

The udder and teats should be washed just before ilking and covered with one of the above antiseptics. fter milking apply some of the following to the bag and ats: Copper sulphate 1 dram and water 1 quart. Some ve used the following with fairly good results:

Tannic acid ....1 ounce;
Salicylic acid ....4 drams;
Vaseline ....3 ounces.

Apply just after using the copper sulphate solution.

The milk should be boiled before using, especially for ildren. Apparently it has no bad effects on calves not owed to suck.

Varicella or false cow pox is characterized by having ngle celled vesicles and by its rapid course, passing rough the papular, vesicular, pustular and healing ages in six to twelve days. The scab or crust is thinner d not depressed in its centre as in cow pox. The vesles and pustules have the same outline as those of cow x, but are smaller in varicella than in cow pox.

Notice that these are variations in degree rather than kind; this makes it difficult to distinguish true cow x and false cow pox in some instances—especially in e early stages. In varicella there may be successive

crops of eruptions on the udder and teats extending
several weeks or three or more months. Possibly
later eruptions are due to infection by pus germs c
mixed infection. The true cause of varicella is alsc
known. Yet it is infectious and can be transmitte
the milker from one cow to another and possibly from
cow to the milker. A similar disease in men is comm
called chicken pox; so far no direct relation bet
the disease in cows and in man has been establis
No inoculations have been made as in cow pox.

The treatment for this is the same as for cow po

Furunculosis is a disease that is also found on
teats and udder of the milch cow. It is an inflamma
of a hair follicle and its subaceous gland, and of a
tain amount of connective tissue surrounding t
The cause is an infection through the follicle by on
more of the pus germs, usually the *micrococcus pyog*
var. *aureus* or *albus*. Generally the central parts
dergo necrosis, or degenerative changes, forming a s
pus collection, which usually escapes by a break in
skin and rarely by erupting into the milk sinus or r
voir of the udder or ducts of the teat or udder.

Furuncles (small boils) appear usually about the
of the teats, but may occur anywhere on the udde
teats; some report their occurrence on the vulva
perineum.

At first the furuncle is a hard, swollen nodule, a
one-half inch in diameter; in the course of a few da
becomes soft in its centre and with slight pressure
erupt. Another or several more may appear nea
around the first one, and thus a series of succe
furuncles may appear on the teats and udder during
greater part of the period of lactation. Sometimes
nodules are quite deeply situated and remain wit
erupting; these are usually about the base of the

n other parts of the udder; they may be, in some cases, erculous modules.

No doubt that filthy hands, dirty finger nails, open way to infection. Pus germs are very often found dirty finger nails and on the dirty skin of the udder; reover, long, sharp and rough finger nails are fine in- uments for inoculation.

Treatment consists in cleanliness and disinfection. th the finger nails smooth and closely cut, and the ler and hands thoroughly washed, chances for infec- n are very limited.

After infection, wash the udder with water that has n boiled and cooled; apply a 2 per cent. creolin, lysol corbolic acid solution; or corrosive sublimate 1 part l water 1,000 parts. Be sure to wash and disinfect udder well immediately after a furuncle erupts. Re- mber cleanliness of hands, finger nails and udder will vent it.

STRUCTIONS TO THE FLOW OF MILK FROM THE TEAT.

Chronic inflammation or irritation of the lining mem- ne of milk duct or canal in the teat (through which ses the milk from the milk reservoir or sinus in the ; to the bucket or air at time of milking) may lead to raudual thickening of the lining membrane and conse- ent narrowing of the duct. The milk will then flow a very small stream and the calf or milker may be un- e to remove all of the milk, and thus "dry up" that rter or produce clotting of the milk or inflammation the bag ("garget" or "caked bag.") Chronic ammation may be a result of the growth of ms in the small amount of milk left in the milk sinus duct, or the growth of germs in the lining membrane

of the duct. The use of a filthy or rough dilator or
tube may irritate the membrane. The most con
cause of infection, according to my observations, i
employment of filthy finger nails or a dirty knife
move a clot or a temporary obstruction in the duct.
thickening of the lining membrane is usually nea
lower end of the duct, but in one instance I foun
duct obstructed in the entire length in all four teats;
according to the owner, the cow was not careful
properly "dried up."

The duct in the teat may, also, be obstructed
growth in the substance of the teat, which presses o
duct and obstructs the flow of milk. The growth m
in or on the lining membrane of duct and anyw
along its course, but most frequently at its lower
In some cases a false membrane develops across the
sinus or reservoir preventing the flow of milk int
teat; this can be determined by using the milk tu
probe or small dilator.

In extremely rare instances lime-like deposits may
place in the milk ducts and sinuses, and appear i
duct of the teat as sand-like grains or particles obst
ing the flow of milk.

The most common causes of obstruction of the flo
milk in the teat are clots of milk (casein) resulting
infection of the milk by germs getting into the u
through the duct in the teat; retention of milk i
udder for a long time; and catarrhal and other f
of inflammation in the udder. Milk is a good foo
germs, and various kind of bacteria will grow i
many of which will precipitate the casein, thus for
clots in the sinus of the udder.

Treatment of obstructions will vary with the c
tions presented. Narrowing of the duct may somet
be relieved by using dilators (figs. 1, 2); it may be n

eave the dilator in the canal or duct for an hour
just before milking. Be careful to cleanse and
the dilator just before using, with boiling water
d disinfectant. When dilators will not accom-
e desired result, use a small knife blade, lance
or the teat slitter (fig. 5), and enlarge the duct
ace of narrowing; then use the dilator or probe
nt the narrowing of the duct as the wound heals.
imes growths or small enlargements on the inner
of the duct may be clipped off with very small
ointed scissors or twisted off with small forceps.
or sand-like deposits in the sinus may require
able dilatation of the duct with the ordinary or
ilator (fig. 3); or the small forceps may be used
ve the sand-like particles. A false membrane
he milk sinus or reservoir may be pierced and
n with a small knife (fig. 8). Clots of casein
removed by using a milk tube (figs. 9, 10), or by
lators (fig. 3), and complete and frequent milk-
the udder is inflamed use antiseptic injections
lications as directed under head of garget or
ation of the udder.

LOMAS OR WARTS on the bag or teats may be
off with knife or scissors when the cow is dry;
it as deep or a little deeper than the thickness
kin. Care should be taken not to cut around or
opening of the duct of the teat; it might leave
nent opening or the contraction of the scar
ose the duct. After clipping apply once or twice
castor oil, 3 ounces; salicylic acid, 4 drams.

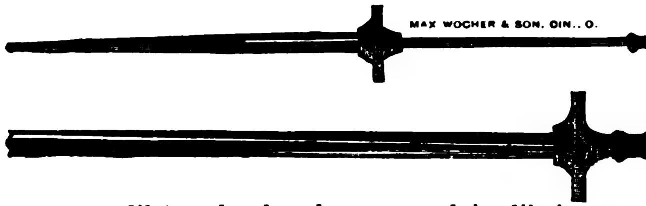
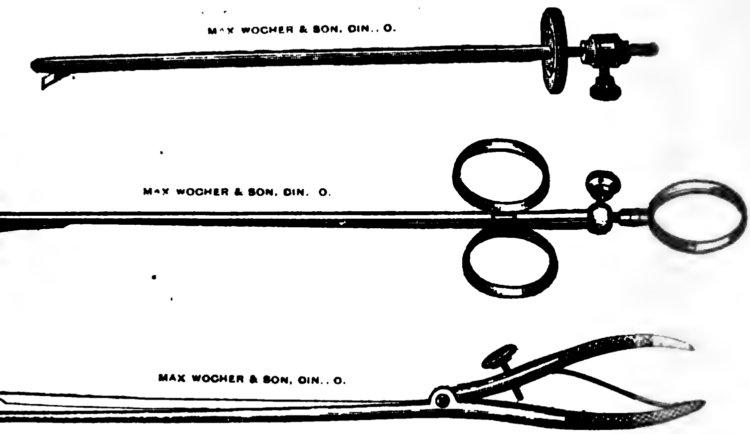


Fig. 1.—Teat dilator closed and open: used in dilating a na
or contracted milk duct.

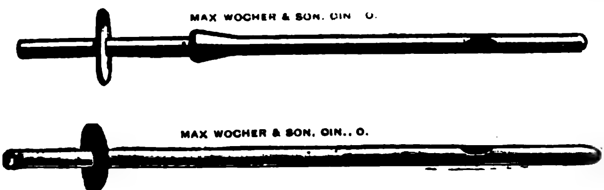
Fig. 2.—Grooved dilator for opening obstructed teats.

Fig. 3.—Spring dilator for removing membranes, clots, and sand-like particles.



gs. 5, 6 and 7.—Three kinds of teat slitters, any one of which
may be used for enlarging narrow or contracted milk ducts.

Fig. 8.—Small tenotome knife (showing only part of handle),
ich may be used in enlarging a contracted milk duct or cutting
opening in a false membrane across the milk sinus.



Figs. 9 and 10.—Milk tubes.

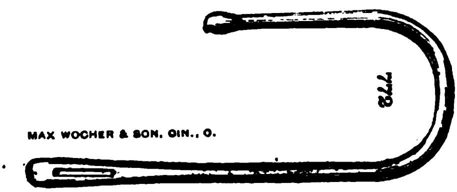


Fig. 11.—Lead probe to be inserted in the milk duct after teat
itting, and retained until healing and danger from excessive
ntraction of the wound is passed.

TESTS OR EXPERIMENTS WITH KALMIA LATIFOLIA

We used a 5 per cent. infusion of the leaves, w
was prepared under the direction of E. R. Miller,
fessor of pharmacy.

I. A scrub cow, about 5 years old, weighing
pounds, was used.

Her temperature was 103.2 Fah., respirations 10
pulse 34 just before the drug was given. At 3 p. m.
was given 3 quarts of the 5 per cent. infusion.

At 4 p. m.—

Temparature	103.2 Fah.
Respirations	10.
Pulse	37.

At 5 p. m.—

Temperature	103.4
Respirations	10.
Pulse	36.

Pulse slightly irregular; cow showed distinct musc
weakness; wabbled about as if drunk; pupils slig
dilated; some muscles showed quivering or twitc
movements.

At 8 p. m.—

Temperature	102.4
Respirations	11.
Pulse	24.

In attempting to move, cow fell and was unabl
rise. Pulse somewhat irregular and weak; muzzle
and mucous membrane pale and dry; pupils greatly
lated (amaurotic); some muscular twitchings.

At 9:30 p. m.—

Temperature	102.
Respirations	12.
Pulse	36.

veak, but more regular; cow could rise, but in
walk fell; pupils still greatly dilated; muzzle
mucous membranes pale. Air was cool, and
shivering.

norning cow was up, but weak and wabbling;
onger and pupils normal in size.

Temperature 100.4
Respirations .... 12.
Pulse .... 36.

bull calf, about 10 months old, was given at
m. one-half pint of a 5 per cent. infusion of
Kalmia latifolia.

At 9:30 a. m.—

Temperature .... 99.2 Fah.
Respiration .... 8.
Pulse ....32.

15 a. m.—

Temperature 100.8
Respirations .... 12.
Pulse .... 54.

time calf was given one-half pint of linseed oil
ams of tannic acid.

m.—

Temperature 101.2
Respirations .... 10.
Pulse .... 48.

as down, unable to rise; pupils dilated; spas-
itching of muscles; pulse weak and irregular.
xt morning calf was up ready for its breakfast.
nic acid may have temporarily prevented the
n of the poisonous principle, but prevented the
producing purgation.

A sorrel mare, about 9 years old, weighing about
ds.

efore giving the drug her

Temperature was ....99.
Respirations .... 12.
Pulse ....30.

At 10 a. m. she was given 1 quart of a 5 per cen
fusion of the leaves of the laurel ivy (Kalmia latif
She coughed considerable during the drenching,
indicated that some of the infusion went into the la
and wind pipe; possibly this made the drug act qu
than usual. At once the mare began to retch, fro
the mouth and breathe rapidly; pupils became dil
co-ordination of muscular action lost; animal ex
and struggling.

At 11 a. m.—

Temperature	96.
Respirations	56.
Pulse	46.

Breathing rapid and irregular; pulse weak; m
membrane of nose pale and of the eye slightly conge
frequent convulsive movements of the limbs.

At noon—

Temperature	95.
Respirations	60.
Pulse	46.

Breathing still very rapid; pulse weak; anima
comes more quiet; pupils still greatly dilated. Mus
twitchings appear first in the face and extended
the surface muscles of the body; occasionally there
convulsive movements of the limbs; surface of body

At 1 p. m.—

Temperature	94.4
Respirations	52.
Pulse	46.

Animal very quiet; pupils dilated; eye dull; m
membrane of mouth and nose of leaden color and m
membrane of eyes congested; muscles continue to tw
surface of body cool.

ιt this time (1 p. m.) the animal was given 1 ounce
95 per cent. alcohol in 4 ounces of water.

ιt 2 p. m.—

Temperature	95.
Respirations	30.
Pulse	48.

ınimal relatively more quiet; pupils continue to de-
ase in size; the mucous membranes of nose and mouth
ome slightly scarlet in color; muscles still twitch.
re animal another ounce of alcohol.

ιt 3 p. m.—

Temperature	98.2
Respirations	28.
Pulse	50.

Pupils normal in size; muscles twitching less and more
ıxed; mucous membranes of mouth and nose about
mal in color, and surface of body warm.

Given another dose of alcohol with small quantity of
ol in it.

ιt 4 p. m.—

Temperature	99.6
Respirations	28.
Pulse	60.

ınimal much better; given another dose of alcohol.

ιt 5 p. m.—

Temperature	100.4
Respirations	26.
Pulse	63.

ιt 5:30 p. m. animal was able to rise with a little help;
scles still twitching some; animal some weak, and
bbling, but able to walk about 200 yeards to a box
ll.

Next morning her appetite was good, and she showed
ne signs of having had a hard drive, but 24 hours later
had entirely recovered.

From the three tests and from numerous cases where
mals have eaten the leaves of Kalmia latifolia it is

very evident that the leaves contain an active po
Several chemists and pharmacists have found indica
of an alkaloid, but a sufficient quantity has never
isolated to test its poisonous effects on cattle or h
or sheep. Sheep and cattle eat the leaves of the s
in winter or spring when pasturage is short, and
animals are hungry for green feed. No doubt they
eat it at any season where pasturage and feed are s
and the opportunity is given to them. This flowe
shrub is very common in nearly all parts of Alab
possibly more common in hilly regions and along m
tain creeks. The shrub flowers in the spring, and i
evergreen, having green leaves all the year around
is commonly called the laurel or laurel ivy.

TREATMENT.—Alcohol acts as physiological or c
ical antidote. Whiskey, brandy or alcohol (dil
may be given every two hours in 1 to 3 fluid o
doses. Also, a purgative of 1 to 2 pounds of Epsom
dissolved in 1 quart of water or 1 to 2 pints of
linseed oil. Do not repeat the purgative under 24 h
One to three fluid drams of creolin or lysol ma
added to the purgative in order to check fermenta
while the bowels are inactive.

The shrub should be cut down, or, better still,
it up and burn it, and thus prevent cattle and s
from getting it; this is possible and practicable in
tures.

The Red Buckeye (Aesculus Pavia, L.) is ano
shrub or small tree whose leaves are poisonous.
clinical symptoms are very like those of poiso
from Kalmia latifolia. The treatment is about
same; at first a good purgative is given and follo
with a stimulant, especially during the period of
pression. In pastures grub it up and burn all the
Buckeye bushes and small trees.

Batchelor (American Journal Pharmacy, 1873
145), found in the seed of the red buckeye, a poiso

.coside ($2\frac{1}{2}$ per cent. in seed). It acted on the cat newhat like strychnine. The leaves are said to be st poisonous just before, or about, the time of flower-. Cattle and sheep usually become poisoned by eat- the leaves, and occasionally by eating the seed.

POISONOUS PLANTS CONTAINING HYDRO-CYANIC ACID.

Prof. E. R. Miller, Pharmacist at the Alabama Poly-hnic Institute, found that the leaves, bark and root the *Prunus Carolineanus* (mock orange) contained lrocyanic acid.

Prunus serotina (wild cherry),

Prunus Virginiana (choke cherry, and

Prunus Persica (peach), all contain hydrocyanic d at times in their leaves. They contain amygdalin, lucoside and emulsin, a ferment or enzyme. In the sence of water the emulsin acts on the amygdalin l hydrocyanic acid, glucose and a volatile oil are med. The action of the ferment is destroyed by boil-.

The leaves of these plants are said to be more pois-ous or contain more hydrocyanic acid when kept in vilted condition, without completely drying out, for eral hours. In the rumen or first stomach of the ox the sheep where there is little or no acid and where food macerates in a watery secretion, neutral or ghtly alkaline, would be an admirable place for ulsin to act on amygdalin and produce hydrocyanic d.

Sorghum (*sorghum vulgare*), according to Peters, de and Avery, of the Nebraska Station, contains lrocyanic acid when it is stunted or checked in wth by dry seasons and also *young, frosted* or second wth sorghum may contain it. No doubt, many of the orted cases of sorghum poisoning are due to acute igestion (bloat) and not to hydrocyanic acid. As

the conditions now stand no one can tell when sorg
is poisonous without a feeding test or a chemical a
sis. Cases have been reported of poisoning from
ing kaffir corn and pasturing Johnson grass, bu
presence of hydrocyanic acid has not been disco
in Johnson grass.

In August, 1902, Mr. J. P. Logan, of Selma,
reported the following facts to me:

Nine head of cattle were turned into a Johnson
pasture for the first time; it was about four o'clo
the evening; the cattle became sick in ten minutes
eating the grass; gave 8 of them linseed oil and a
2 died that night and 6 recovered; one not treated
in three hours.

The Johnson grass from this field was teste
hydrocyanic acid, and none was found in it. Th
coveries, by the treatment given, seems to indicate
the cattle had acute indigestion.

In July, 1899, during a very dry time, Mr. Ha
a dairyman of Birmingham, Ala., turned 20 cows i
sorghum field that had been injured by army w
and by drouth; in twenty minutes, he says, 18
dead; 2 were saved by treatment. The 18 cattle
within 50 feet of the gate through which they p
into the sorghum field.

Hydrocyanic acid is a very unstable compound
this accounts for the fact that many plants that
times contain it do so only under certain cond
and for a short time. Any condition that chec
stunts the growth of sorghum should lead one t
gard it as a dangerous feed until proven otherwis

Symptoms of hydrocyanic acid poisoning ar
same regardless of the source of the drug. Of cour
larger the dost the more rapid and fatal its actio
can be absorbed from the unbroken skin when in a
watery solution: it is readily absorbed from the al

ıry canal acting as a sedative and anaesthetic on the ıucous membranes. Small doses depress the heart ; stimulating the vagus centre in the medulla; large oses stimulate the vagus centre and depress the heart ; acting directly on it, paralyzing it almost instantly. he vaso-motor centre is paralyzed and blood pressure ılls very low.

The respiratory centre is paralyzed usually before ıe cardiac or vaso-motor centres. Toxic doses produce ısensibility and coma; in animals convulsions may oc-ır. Large dose paralyze the peripheral nerves and ıe voluntary muscles. Shortly before death the spinal ord is paralyzed. The pupils are dilated. In brief, ydrocyanic acid quickly depresses respirations, the ılse or heart action and blood pressure, and paralyzes ıe muscles and nerves of the limbs; depresses the ac-on of the alimentary canal and dilates the pupil. In any cases these actions are so quick that there is no me to give antidotes or treatment. Drowsiness, run-ing at eyes, twitching of the muscles, staggering gait, ıability to stand, involuntary passing of urine and ces, dilated pupils, frothing at the mouth—are given ; Peters as the prominent symptoms.

In cases where time is given for TREATMENT give a imulant of 1 to 4 ounces of brandy, whiskey, or diluted cohol or ether. When the animal can not swallow, ve the drug per rectum or hypodermically. Stimulate spiration by holding dilute ammonia to the nose and ; giving one-half grain doses of strychnine hypoder-ically once every three or four hours.

As soon as the animal can swallow give cow or ox 1 ıart of melted lard (not too hot), or 1 quart or raw nseed oil and 1 pint of syrup diluted with 1 pint of ater. If cow begins to swell from the formation of ıs by fermentation in the stomach and intestines, give ounce of creolin in 1 quart of water. Do not repeat ırgatives under twenty-four hours. Sheep and calves

take doses of medicine about one-fourth as large a
grown cattle.

In all cases where possible prevent the animal
eating the leaves of the mock orange, the cherry
the peach—especially wilted leaves on recently c
pruned branches. In case of sorghum, always te
stunted sorghum by cutting and feeding a little b
turning cattle into the field to graze on it. In
it is best and safest to begin to feed it gradually, b
soiling method, and after the cattle have been br
up to full feed in that way, they may be turned int
field for a short time each day until they become a
tomed to it. Very few cases of accidental pois
have been produced by cutting sorghum and feedi
to cattle; yet such instances have occurred both
sorghum and kaffir corn.

Phytolacca decandra has been reported as pois
for cattle. G. R. White, in the Journal Comp.
and Vet. Arch., 1902, p. 439, reports that 5
out of a herd of 13 were affected with hae
hagic enteritis accompanied with dysentery.
cattle had eaten large quantities of phytolacca
White attributed the enteritis to the eating of
plant.

From an unpublished article of Prof. E. R. Mill
the Alabama Polytechnic Institute, at Auburn,
tained the following facts:

Three different times Prof. Miller became sick fo
ing the grinding of the roots of phytolacca. The
ness was very like the preliminary symptoms of
enza; alternate periods of chilling and high feve
tense headache; insomnia and restlessness; some i
tion of nose and throat; lasting for about 24 hours.
students were very similary affected; also a
ground the roots of phytolacca and was similarly t
led. One student was not affected; another had i

of the nose and throat and eyes, lasting about 24 rs.

he professor became affected three different times; udents and a negro once and one student was apparly unsusceptible. The following was reported to of. Miller:

boy applied a decoction all over his body for the , it produced vesication, and the skin peeled off from a blister. It is reported that many people eat ng poke root as "greens;" possibly the cooking proes some change that renders the poison inert.

t is also suggested that the young plant may not have contain the toxic principle; as a rule, most plants tain the greatest amount of their active principles before or at the time of blossoming.

he seed or fruit of phytolacca are said to contain *tolaccin*, phytolaccic acid, sugar and gum; the root phytolacca a resin, probably a glucoside and a vola- acid. Prof. Miller and his students have obtained ong indications of several alkoloids.

Having never treated a case of phytolacca poisoning, an only suggest that small oleaginous purgatives be en and the animal be fed soft feed in small quanti- . Raw linseed oil one-half pint and creolin 1 to 2 ms might be given once or twice per day. If the mal is in pain give 1 to 3 drams of fluid extract of adonna or 4 drams of tincture of opium two or ee times per day.

DYSENTERY IN YOUNG ANIMALS.

oung calves, lambs or colts may have an infectious n of dysentery that begins usually during the first days, or not later than two weeks, after birth; in e instances infection may occur in calves several ks old. The cause of the disease, according to ard, is a short, stumpy, bacillus with rounded ends; quently found arranged in parrallel lines, like a

comb, with short, close teeth; sometimes they ar
linear series, having very short joints, becoming thi
until last segment, which is longer and club-sha
Some are swollen in the centre and drawn into thr
at extremities; others are ovoid like cocco-bac
From Nocard's description the bacillus seems to tak
a variety of forms; it is found in pus and in fre
intercellular masses. It is an obligative aerobe; st
always by Gram's method; grows in or on all med
a temperature above 86° F. (best at 95° F. to 100.4
grows best on coagulated blood serum where in 3
39 hours appear a number of colonies with a shi
surface, slightly raised in the centre, and appearin
send a number of roots into the medium; these colo
are white on serum from the horse, bright yellow
serum from the ox, and gray on coagulated blood.

Nocard, Lasage and Delmer believe that the pr
pal, if not the only, method of infection is by way o
umbilical (navel) cord. Infection occurs during b
or immediately following birth while the cord is s
Possibly it occurs in the vagina or vulva, or most li
after the cord is torn or broken, and the young i
the ground. Nocard attempted to infect calves by
alimentary canal and by the respiratory passages,
failed. But he succeeded by subcutaneous inocula

The experiments of Nocard, Lasage and Delmer
confined to calves in Ireland and on the continen
Europe; and their tests may not be conclusive, yet
evidence points very strongly toward navel infectio

Law, Friedberger and Frohner, de Bruin, Mou
Deikerhoff, and others believe the disease is infect
Many attending or predisposing causes are given, s
of which are aids to transmission or infection. The
lowing are given by various authorities as causes,
of infectious dysentery and of ordinary diarrh
or dysentery:

The young or new-born offspring failing to get

ilk (colostrum) which is laxative in its action consequently required to remove the meconium feces) from the alimentary canal of the young. ıt it the young animal is liable to have indiges- onstipation or diarrhœa: any one of these condi- ıight favor infection with the germ of dysentery. ıy, dirty milk; sudden changes from whole milk ı milk, or from skim milk to whole milk, or sweet › sour; putting a young calf on a cow far ad- in the period of lactation (milk contains too solids); adding too much meal to milk or giving ıch dry meal or corn to young calves when the y glands are insufficiently developed to digest rchy food; giving cow's milk to the foal without dilution or modification; filthy buckets or ud- lamp, filthy, unclean stalls, barns and pens; bad from infected wells, tanks, troughs or vessels; ed grasses; mouldy, decaying, irritating vegeta- grains or hays; too much cotton seed or cotton eal; allowing colt or calf to suck when dam has ver-heated by violent exercise; feeding young calf only once every twelve hours; feeding too much feeding); great irregularity in feeding, allowing colt to get very hungry and then rapidly devour- 'ull feed.

PTOMS.—Some cases begin with constipation; with soft, soon becoming watery, bowel dis- s, which may be white like undigested milk, or ı or yellow in color. At times the calf or colt is s, with more or less straining to pass feces; appe- tops sucking) is lost; abdomen may become dis- or swollen and tender or tucked up (contracted) nder; feces becomes frothy, bad smelling and mes streaked with blood; calf may bellow and r; the calf, colt or lamb may become dull,, stupid, emaciated and die in one to three days, or may ıe or two weeks and die or make a slow recovery.

Some cases have pneumonia, inflammation of the art
lations, peritonitis, laminitis, hepatitis (inflamma
of the liver), or opthalmia (inflammation of the ey
This disease is very frequently found in he
where infectious abortion or tuberculosis exists.

About 80 per cent. of the cases in foals are fatal
to 90 per cent. in calves and 66 per cent. in lambs.

POST MORTEM CONDITIONS—Here and there may app
erosions or desquamations and red or congested area
the mucous membrane of the intestines, and someti
in the stomach. Catarrhal exudate or pseudo-membr
ous patches may occur on the mucous membrane of
intestines. Peyer's patches may be infiltrated
prominent; sub-mucous infiltrated, softened,
marked by small red spots (hæmorrhagic spo
Sometimes hæmorrhages may be found in
small or large intestine or in the stomach.
calves and lambs the desquamation of epit
ium is most marked near the pyloric end of the fou
stomach. The contents of the intestines may be yell
ish, white, gray, red, mucou-purulent and very fœt
The intestinal lymph glands are usually enlarged.

Some cases show inflammatory changes in the lu
liver, peritoneum, kidneys, spleen, heart, articulati
and eyes.

TREATMENT.—Prevention is the only means of
cessfully combatting this very fatal disaese. Clea
ness and disinfections will usually keep it f
a place or herd. The stalls, pens, barns, buckets, wa
feed, milk, cows and calves must be kept clean. R
lar feed, with proper quantity and quality, av
ing any or all sudden or radical changes
the extremities of too little and too much feed,
tend to maintain healthy calves, colts and lambs.

It is always safer and better to milk a cow tha
far along in the period of lactation and dilute the m

h water that has been boiled and cooled and feed it he calf than to turn a young calf to such a cow. Do force meal, corn or other grain upon the young calf ore its digestive apparatus is sufficiently developed ligest them. At least wait one or two weeks and n begin the use of such feeds very gradually. Never mit the calf to eat mouldy, decayed or rotten feed nay or vegetables; keep it in well ventilated, clean, stall or pen and give it freedom in a clean, grassy ture all the time that weather will permit.

Iocard recommends the following:

White scours is generally the consequence of an bilical (navel) infection which takes place at the e of parturition. Farmers may prevent the disease conforming strictly to the folowing instructions:

. Cows that are at the point of calving should be vided with dry and clean litter until after the act parturition.

. As soon as the premonitary signs of parturition observed the vulva, anus, and perineum ought to be shed with a warm solution of lysol, of a strength of grammes to a liter of water (2 per cent. solution). the same time a large quantity of this solution may used to syringe out the vagina.

. As far as possible the calf ought to be received a clean cloth, or at least on a thick layer of fresh er, which has not been soiled by urine or excrement.

. Immediately after birth the cord should be tied h a ligature (strong string) that has been soaked ysol. (The tie is made 2 to 3 inches below the abnen and the cord cut off one-half inch below the ture.)

. Mop or cover the umbilicus and remainder of the l with the following solution:

Rain water	1 quart.
Iodine	30 grains.
Potassium iodine	1 dram.

6. The disinfection of the umbilicus and cord sl
be completed by applying the following:

Methyl alcohol	1 quart.
Iodine	30 grains.

7. When the alcohol has evaporated the oper will be completed by dressing the cord and umb with a thick layer of iodised collodion (1 per cent. soon as the collodion has dried the calf may be left its mother."

In one outbreak of infectious dysentery in val have had good results by employing the following powder:

Tannic acid	3 ounces.
Boric acid	3 ounces.
Iodoform	4 drams.
Salicylic acid	4 drams.

Mix and apply to the ligated cord and umb (navel) immediately after birth and two or three per day during the first three days. This thoro disinfects and also dries up the cord very quickl can be applied with a dust blower or sifter.

If calves are allowed to suckle a cow, it is alway to wash the udder once or twice daily with a 1 or cent. solution of creolin or lysol. Just before bi is wise to wash the vulva, anus, perineum and tail cow with one the above disinfectants.

Barns, lots and pens must be thoroughly cleane disinfected. Change calves and cows from one cl and disinfected place to another and keep well entirely isolated from sick ones. Use plenty of whitewash, carbolic acid, creolin, lysol and other fectants on walls, floors, etc. Above all wash and often the walls and stalls.

Curative Treatment is not very promising; hen great number of remedies herein suggested.

It is usually best to begin the treatment with a gative in order to remove the fermenting and irrit materials in the alimentary canal.

'or the calf or colt give 1 to 2 ounces (2 to 4 table-
onsful) of castor oil; the lamb can be given one-fourth
much. Or, rubarb may be given in 30 to 60 grain
es to the calf or colt and 7 to 15 grains to the lamb.
calomel 6 grains for colt or calf and 1 grain for
ıb.

'incture of opium is sometimes given with, or fol-
ing, the purgative.

ıaw recommends the following:

Tincture of cinnamon	....	2 fluid ounces.
Chalk	....	1 ounce.
Gum arabic	....	4 drams.

Iix and give to calf or colt 1 tablespoonful 2 or 3
es per day.

'adæc uses:

Subnitrate of bismuth	....	5 grains.
Salicylic acid	....	5 grains.
Naphtol	....	20 grains.
Syrup	....	5 ounces.
Distilled water	....	4 ounces.

Iix and give to calf or colt 1 to 2 tablespoonsful
er each time it is fed.

ınother authority advises the following:

Coal tar	....	5 ounces.
Boiling water	.. ....	6 quarts.

ıet cool and give one-half pint evry half hour. This
very useful in cases where liver is involved, (indica-
by yellow mucous membrances).

ıime water is sometimes useful: Give on to four
lespoonsful after calf has taken its milk. It is well
boil the milk and allow it to cool without putting
d water into it.

Some give a one or two per cent. solution of creolin;
ɔ 2 ounces for calf or colt once or twice a day.

f the calf, colt or lamb is very weak, it may require
timulant; such as coffee or a teaspoonful (calf or
t) of turpentine with egg or milk, or tincture of cap-
ım, a teaspoonful.

Wine of ipicac is said to be very valuable in s forms of dysentery in man. It may be given to calve colts in 1 tablespoonful doses; 10 drops to the lam

ACUTE INDIGESTION IN CATTLE.

This is sometimes called "hoven" or "bloat." In first stomach or paunch, there may be undigested, menting food, resulting in the formation of gases(bon dioxide, hydrogen sulphide, etc.) and possibly s acids or toxic alkaloids or glucosides.

The causes are not always apparent, but general is due to over feeding or sudden change from dry to green succulent peavines, potato vines, corn, ghum, clover, oats, potatoes or turnips which und fermentation in the paunch. When a cow or an ox down for some time, as in milk fever, lung fever or fever, the digestive organs may be checked in actio partially paralyzed; then fermentation may occur.

SYMPTOMS.—If gas is formed the abdomen bec distended and resonant; (left flank larger than right,) respirations are rapid and shallow; tempera about normal; animal may grunt or moan.

In some cases (Dieckerhoff) the greatest swellin distention of the abdomen may appear in 15 to 20 utes after eating clover (especially when the clove in a partially withered or wilted condition on a day).

In some cases of indigestion there is no appreci quantity of gas formed and consequently little or no tention of the abdomen and flanks; the appetite ma partially or completely suspended; little or no r nation (chewing and regurgitating of the cuds), paunch or first stomach is inactive or paralyzed; bo normal in acting during the first day, constipated or active thereafter, except in few instances where the b els may be very loose and active; pulse may be acce

nperature normal; and in the cow the flow of
greatly decreased. The animal may die in 1 to 4
may recover in from 2 to 8 days. When toxic
kaloids or glucosides are rapidly forming death
ur in a comparatively short time.

nent may be preventative or curative. Avoid
ing of concentrates; such as corn, cotton-seed
ts, wheat etc., and decayed, moldy, rotton feed.
s most difficult to prevent cattle from getting
a green feed when they accidentally get into the
ghum, pea patch or clover. Prevention means
l care and watchfulness. Change from dry to
ed gradually. Curative remedies are directed
emoving the undigested food and preventing fer-
n and death while removing these materials
ailmentary canal. If the animal can swallow,
2 lbs. Epsom salts and 10 to 20 drops of croton
e quart of water; do not repeat this under 12 to
. Follow or precede this with 1 tablespoonful
creolin in 1 quart of water. If you have noth-
and the animal continues to bloat or swell,
ne creolin solution every two hours until the
ceases. If you have no creolin, dissolve as much
t as you can in two quarts of warm water and
uarts of salt water every 3 or 4 hours. If you
Epsom salts give 1 to 2 pints of raw linseed oil,
oil, or cotton seed oil, or melted (not hot) lard.
er, do not repeat the dose of Epsom salts or
r 12 to 24 hours.

e the animal is greatly swollen and about to
e purgatives and antiseptics can act, then you
cture the rumen with a trocar and canula or a
This should be done on the left side some where
the hip point (haunch) and the last rib.
the left flank with soap and water and weak
solution; cut an opening through skin, about

one-half inch long; now push the trocar and canul the paunch (3 to 4 inches deep), pull out the troc let the gas escape through the canula for one or hours; when you desire to remove the canula a insert the trocar into it and remove both togethe prevents infection of the wound. In case you ha trocar get a long quill or better a joint of swamp about the size of a lead pencil or pipe stem, boil water, (at least scald it), make a sharp bevelled on one end, and push the sharp end into the p through the opening made in the skin as directed After removing the trocar and canula or cane apply weak creolin solution to disinfect the place give purgatives and antiseptics internally if not al given.

Feed carefully for the next few days, always giv every day; granulated salt is better than rock sal

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PART II.

BY G. F. MATTHEWS.

ABORTION.

Commonly known as miscarriage or losing, sli or slinking the calf, colt, lamb, whichever the cas be.

Abortion may be defined as delivering (parturi before the end of the regular period of preg (gestation) or before the young has fully com fœtal life whether the little creature be dead or Foetal live refers to life before birth, the young this time being a foetus. The average period of nancy in farm animals is for mare and jennie, 11 m and 15 days; cow 9 months and 15 days; sheep an 5 months; sow 4 months. If an animal delivers days before time the deviation is unimportant sin

of pregnancy may vary a few days with different
ıals and under different circumstances.
tion, from an economic standpoint, takes rank
former animals as follows: Cow, Mare, Sheep,
The cow is the most liable while the sow is sel-
bject to the mishap.
iability or whether the fœtus is capable of living
ıer question. Usually it is dead. A dead foetus
delivered at any time during pregnancy, but
bortion occurs in the first two-thirds of pregnan-
foetus is always dead. In the last third a live
frequently born.
ater the stage the more likely is the little crea-
live. Many die immediately, and others are weak-
prove to be absolutely worthless, and in rare in-
one becomes sufficiently vigorous to develop into
ble animal.
idea of the number of living calves delivered
ting cows in the last months of pregnancy and
lue may be had from the record reported by Nel-
the New Jersey Experiment Station. Twelve
orted. Four births occurred between the 6th and
nths; four between the 7th and 8th months;
ır between the 8th and 9th months. Three of
lve were dead: 1 died; 6 were killed and 2 were
Thus only a small percentage were of sufficient
to be kept, and it is a question if it ever pays in
g run to raise any of them.
tion may be either non-infectious or infectious.
ccurring in the latter form it assumes an enzootic
pizootic type and it is of greatest importance to
ze this form in order to prevent the spread of the
on.

Non-infectious abortion.

nfectious abortion results from some known
r accident, irregular feeding, improper feed, etc.,

or happens only as a casual affair not preceded or fol-
lowed by miscarriage in the same individual or o
members of the herd. Not only should the home l
be excluded as a sourse of the disease, but the mis
should be free from any relationship whatever wi
similar accident among cows which the attending
may have served.

Causes: The causes of non-infectious abortion are
numerous to discuss in detail. Frequently it is t
ascribed to the poor condition of the pregnant anin
This may result from insufficient or improper food
irregular feeding. The fœtus dies for the want of n
ishment, and is expelled as a consequence. Chr
wasting diseases may have a like effect by deranging
gestion impairing assimilation and impoverishing
blood.

According to some authors an extremely fat condi
predisposes an animal to abortion. This is said to
cur most frequently in old cows of improved beef br
suffering with fatty degeneration of the heart, the
culation being weak and irregular and insufficien
supply the fœtus.

Drinking ice-cold water and feeding upon past
covered by frost, or eating herbage which has been
jured by frost, have caused abortion. One writer
ports an instance where one-fifth of the pregnant ewe
a flock of sheep aborted immediately after drinking f
a hole made through ice.

Overloading the paunch (rumen) with succu
foods, like green sorghum, clover and cow-peas, es
ially when covered by dew; apples, sweet potatoe v
or tubers, etc., and gorging the animal with stimu
ing foods like corn, wheat, peas, beans, cotton-s
and cotton-seed meal are exciting causes.

Foods improperly harvested and improperly cu
musty, molded and partially decayed foods may

p fermentation in the paunch, which compress the omb and kill or displace the fœtus.

Acute diseases, manifested by colicy pains or circuatory disturbances, may be followed by abortion. Disases of the rectum and urinary organs, as diarrhoea nd inflammation of the kidneys, bladder, etc., are preisposing causes. Parasites, like worms in the intesnes, liver or lungs, and lice, are accessory causes.

Medicines injudiciously administered to ailing aniials are as liable to cause abortion as the affliction. arge doses of purgatives are to be avoided, also anher class of drugs known as ecbolics, rye-smut, cornnut; cotton-root bark; cotton-seed, and cotton-seed eal, probably possess to a slight extent the active rinciples of cotton-root bark. Evil effects from this ource have been overestimated. Grain smuts, seeds, eaves, etc., containing medicinal principles, must be onsumed in enormous quantities usually to cause delirious effects upon healthy organs. Taking for exnple, the smut of rye (ergot), which is the most poent of the class; it is said to require 10 pounds of the elect drug to produce acute poisoning in a 750-pound ow. Such enormous quantities are not likely to be onsumed at one time. The chief danger is in pasturg cattle continually on pastures where smut is abunant. A moderate quantity is consumed each day, ithout bad effects at first, but after a few days the ctive medicinal principles in the smut will have acimulated to such an extent as to cause chronic poisning (ergotism), and abortion. Chronic poisoning rom rye smut is rare, and it is questionable if corn nut ever has that effect. Drugs, like spanish fly, hich irritate the urinary organs, and purgatives which imulate the involuntary muscles of the rectum to exessive action should be given to pregnant animals with aution, if at all.

Sudden fright, thunder storms, chasing by dogs, and

the smell of blood, or the discharge from an abort animal, may cause abortion in sensitive, highly-l Jerseys.

Miscarriage may follow sudden changes in the weat especially if the victims are poorly nourished.

Violence in any form is a fruitful cause of abort Mares which "balk" or refuse to pull and cows wl "sulk" or refuse to travel about from the unmerc beatings received.

Jars and jolts in railway cars, and shipping long tances may cause the trouble.

Mounting other cows or being mounted by other c or the bull; falling into ditches or having the hind slip unexpectedly into gutters behind the cow; ju ing fences; crowding through door ways; and so on definitely may result in abortion.

While it stands to reason that slight injury is less ble than severe violence to result in abortion, the res cannot be judged by the extent of the violence, for one time an animal will carry her fœtus successf through a violent accident, and at another time a after sustaining the most insignificant injury.

In one case a calf which was born alive, but requ the assistance of a surgeon for delivery, and died a consequence of the manipulation, was found to have hind leg bent at right angle just above the hock. W the flesh was boiled off, the bone showed evidence having been broken, union being complete with the ception of a small spicule of bone projecting from part where the tissue had separated most. The ow had not seen any accident, but remembered a breal a rail fence, made, probably, by this cow, about month prior to delivery. At any rate, it shows tha pregnant animal may suffer violence little short of de of the fœtus and not abort.

On the other hand, the most insignificant accident be responsible for abortion. A mare had one hind

o slip unexpectedly through the board crossing over an pen ditch. The foot sank but a few inches, not more han 12 or 15, as the drain was not deep. However, the nare aborted and the owner could ascribe the mishap o no other cause.

A dead fœtus is seldom retained, though in exceptional ases it may remain in the womb until quite putrid. The œtus may be killed as a result of external violence; die rom displacement or twist of the womb; excessive col-ection of fluids in the fœtal membranes; deformation; iminished circulation or impaired nutrition, whether ffecting it directly or indirectly through condition of he mother.

The symptoms, cause and after treatment does not iffer materially from that of infectious abortion. The rincipal requisite in treatment is to remove the cause.)irections for treating retention of the after-birth placenta) always a serious consequence in these cases nd prolapsus of the uterus, will be given in the treat-nent of infectious abortion.

Infectious Abortion.

By infectious abortion is meant that form of abortion vhich has a tendency to recur in the same subject or is ssociated with—proceeds or follows—abortion in other nimals. Single cases caused by infection cannot be dis-inguished from the non-infectious sort.

Prevalence in Alabama.—

Infectious abortion is said to be widely distributed ver the civilized world. In Alabama it is confined argely to the herds in the vicinity of the larger towns nd cities.

The hardy range or "scrub" cattle of the State, like vild cattle, are remarkably free from the disease.

At present marked interest is being manifested in reeding beef cattle. This interest is increasing.

Several herds have been started in various parts of

the State, and there is a growing desire to breed up
native cattle. Improved stock have been shipped f
the North, Northwest and West for this purpose.

One purpose of this article is to acquaint present
prospective breeders with the nature of the disease
warn them of the dangers of introducing a disease w
would prove detrimental to the business. The first re
site in breeding beef cattle is to secure the greatest n
ber of vigorous calves. Infectious abortion strikes
certain fatality at this part of the industry. The
way to avoid incurring the dangers of an infectious
ease is to prevent its introduction.

Dairymen, especially those who keep cows for
and milk products, often fail to realize the economic
portance of the disease. Such dairymen do not value
calves. Indeed, the loss of the calf in this case amo
to nothing, and the matter might be dismissed if t
were not other sources of loss. There is another re
why some persons are led to believe abortion is no di
vantage. Occasionally a cow having missed one cal
period, aborts before the next and begins to give a
flow of milk.

This is well illustrated by the report of four c
which came under the observation of W. W. Cook of
mont Experiment Station. So also is the pecuniary
illustrated.

One cow aborting two months before the time to
a calf, yielded 200 gallons of milk, or the equivalen
70 pounds of butter less than she had yielded
previous year after normal birth.

Loss from the second cow was 240 gallons of milk
a butter equivalent of 60 pounds and from the third
gallons of milk or 75 pounds of butter. The fourth
which had been milking 16 months and had carried
fœtus 7 months, miscarried without aparent disad
tage. In fact, this cow the previous year, 5 months a
delivery, gave 15 pounds of milk per day and 21 pou
per day 5 months after aborting.

Causes.—Infectious abortion, as the name implies, caused by an infectious agency, or contagion. Auors do not agree as to the nature of the germ or as to w the germ brings about the act of abortion. Amerin and European investigators do not agree and Europan investigators do not agree among themselves as to e identity of the microbe. Some claiming a microccus and others a bacterium as the effective agent. nerican investigators have found true bacilli belonging the coli group in the membranes and womb of aborting imals. Aside from this there are other reasons for sepating the disease in America and that in Europe into o different types. The disease in Europe is more virunt; a longer time is required to establish immunity; d there seems to be a difference in the manner in which ortion is brought about, viz.: in some cases the germ vades the fœtus, inhabiting the alimentary canal, in e instance, and the meninges of the brain and spinal rd in another; again the infection is insinuated been the cotyledons on the maternal and fœtal memanes, and modifies the fœtal food supply, causing in ther case the death of the fœtus, which, for that reason, subsequently expelled. In America no writer has ever ported the presence of the germ in the fœtus, and the umber of living fœtuses born indicate that death from odified food supply is not a prerequisite.

In view of these facts the writer will confine the disssions to what he may term the *American* form of *Inctious Abortion.*

It is singularly significant that all American investitors have found closely related, if not identical bacilli sociated with the disease.

Chester, of the Delaware Experiment Station, isolated om the placenta of an aborted calf, a bacillus closely sembling the bacillus coli; which produced slight tarrh of mucous membranes when injected into the gina of a cow. Law and Moore, of New York, found

in a number of aborting cows, widely distributed o
the State, a bacillus almost, if not identical, with baci
coli in form and culture characteristics. This, a
caused more or less catarrh when injecting into
vagina of healthy cows. Law further states that
particular microbe could not be found in the vag
discharge of cows in herds free from infectious abort

Kilborne and Th. Smith studied a bacillus of the
group, infesting the vagina of aborting mares. Supu
ing catarrh resulted from vaginal injections in ma
and cows.

At this Station we have isolated from vaginal
charge and from ulcers on the vaginal mucous membr
of two heifers which have never been bred, but which
supposed to be infected with the abortion microbe
bacillus which is indistinguishable from the baci
coli morphologically and closely resembles C
ter's bacillus in culture characteristics. Inoculation
the mucous membrane of the vulva of an old cow,
pregnant, was followed by the formation of a small u
and a discharge.

The cow came in heat in a few days, but the sy
toms were more pronounced than in ordinary oestru

Planted into the prepuce of a rabbit a small u
formed with undulating borders surrounding a sligh
depressed granular surface.

The heifers in question, one an Angus and the ot
a Shorthorn, came to the hospital last February wit
discharge from the vagina.

The Angus had been to the State fair in Novem
previous, being shipped to and from the fair by r
No disease of the kind had ever been observed in
herd prior to this outbreak, and it is supposed t
the disease was contracted while at the fair or from
stock cars in which the animals were shipped.

There is a bare possibility that the germs might h
been brought unintenionally to the Station on

; of an attendant who came from another State ne month before the disease was first noticed.

lcers were found on the vaginal membranes of gus, but there was evidence of extensive pre- lcerations. The Angus was supposed to have ted the disease first, gradually acquiring a re- : for the microbe, and was on the way to recov- 1 this case the disease yielded readily to antisep- tment.

Shorthorn probably contracted the disease from gus, though a steer occupied a stall between the the barn. This heifer was at the climax of an ttack. There was ecchymosis of the mucous ne of the vagina as for farward as could be seen, tensive exfoliation of the epithelium and ulcer- The discharge was odorless, but dirty, grayish vily turbid.

vagina was irrigated with 2 per cent. creolin 1 and packed with iodoform gauze once per day course of two weeks.

discharge soon ceased, but a kind of stimulation genitals, probably irritation, continued as the was frequently in heat.

um, or heat, recurred every seven to ten days, ted by a swollen and loose condition of the The discharge was somewhat profuse and yel- translucent instead of transparent.

ulcers gradually disappeared from the visible membranes and the application of medicine was nued. About two weeks later the animal was up for final examination and dismissal. But it nd that another crop of ulcers had appeared. ne the catarrh was much less severe, and the ulcers were very few, limited in size and closely ed the one on the prepuce of the inoculated

nimal was subjected to another course of treat-

ment. Iodoform incorporated in vaseline was app
at intervals of three days by means of a swab of g
introduced into the vagina and so manipulated a
smear the salve over all parts of the vagina. Rapid
provement followed.

About three weeks later another examination
made and a few small transparent vesicles but l
larger than a pin-head were found. These ves
were kept under observation one week. No chang
curred in size, but they became somewhat more ra
and translucent. There was no zone of congested c
laries surrounding the vesicles, but the vaginal mu
membrane remained more congested than normal.

This is believed to be the third crop of colonies.

Where could this renewed infection have come fr
The tail and external parts were carefully disinfe
and cleaned from all locia. Evidently the source o
infection was from the uterus (8) Fig. 12—through
os uteri.

There is no doubt that the microbe inhabits
womb. Law and Moore found it on the "uterine mu
and fœtal membranes."

Then, the successive reinfections of the vagina i
counted for by the fact that the microbe growing in
uterus (8) is protected from therapeutic measures
passing out through the os uteri (7) re-establishe
footing in the vagina as soon as the field is free f
disinfectants. This, doubtless, also accounts for
almost invariable failures, however thorough the m
ures may have been to rid aborting animals of the
fection.

Modes of Distribution.

1. The infection may be introduced into a herd
the admission of cows or bulls from infected he
When a newly purchased cow is the carrier, whe
she may abort or not, transmits the disease to o

lly in adjoining stalls, which miscarry, sometimes after another in consecutive order down the line of s. The disease may be confined to one side of the for years. If the bull distributes the infection, in- on occurs promiscuously through the herd.

Allowing the bull to serve infected cows or pat- ing a bull which has served infected cows.

Shipping in cars and keeping in pens or stalls h have been occupied by aborting animals.

An attendant who removes the afterbirth of an ted cow has been known to transmit the disease to r cows operated on afterwards.

It is possible to have the infection transmitted one herd to another by the interchange of help or ecuring milkers, herdsmen, etc., from dairies where lisease prevails. Overalls and like clothing which vorn at one farm go with the owner to new locali- oftimes without even a washing.

The manner of handling manure in cow barns e one trench receives the excrement from a whole of cows in open stalls may be responsible for the ading of the disease in the herd. It is the rule to n at one end of the trench and push the manure g until enough accumulates to shovel in quantities, the discharge from an aborting cow may be scat- behind a dozen or more animals.

ow the germ gains access to the genetal organs may xplained as follows:

hen the bull is infected, it is easily understood how s would be introduced into the vagina at copula- There are a number of instances on record where purchase, borrowing or patronizing of bulls have responsible for serious outbreaks. More often the se spreads from one cow to the next nearest, and so s already indicated.

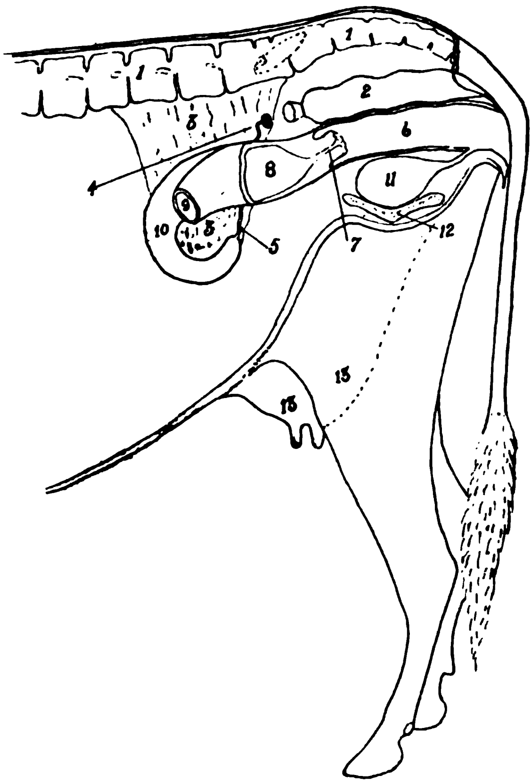

Fig. 12.—1, backbone; 2, rectum or last gut; 3, broad ligam womb; 4, ovary or pride; 5, Fallopian tube; 6, vagina or firs sion of womb; 7, os uteri or opening between the two parts womb; 8, uterus or deep portion of womb; 9 and 10, horns womb; 11, bladder; 12, pelvic bone. [Nos. in ( ) refer to Fig. 1

In order to understand how this may occur reader who has no knowledge of the female gener organs, is referred to the diagram Fig. 12.

To exemplify one possible course the infecting a might take, we will say: A cow lying in the stal the switch on the tail soiled in a manure trench, w

been smeared with infection from an aborting sub- The cow goes out to pasture; the filth dries and attered over the rump by the switching tail. Some ıs lodge upon the vulva and find their way into the ıa (6) where they multiply with prodigious rapid- The germs are actively motile, and make their through the os uteri (7) into the uterus or inner ion of the womb (8), thence through the horns of womb (9 and 10), and possibly up the Fallopian s (5) to the prides or ovaries (4).

emembering the catarrh caused by the microbe, it d be strange indeed if its presence in the small opian tubes did not sometimes result in obliteration ie passage and sterility. In fact, many animals do me sterile.

The existence of the Microbe in the Womb.

ie indications are that the germ causing abortion ins in the infected womb for years, though no than one, two or three abortions may occur. This t incompatible with our knowledge of germ life. A blood from one of our Southern cattle, apparently erfect health, injected into the circulation of cattle ght from the North is followed by violent fever, cal of Southern cattle, or Texas fever. In this way proved that an animal which has had no fever for two or more years harbors the living parasite in lood, and is capable of transmitting the disease to eptible animals. Authorities are now agreed that infection causing swine plague, often mistaken for cholera, live in the lungs of the pig after recovery the acute attack, and continues to be a source ıfection for other pigs many months and possibly s. This explains the reason the disease breaks year after year when once introduced.

Nelson, after the second year's experience wi disease in the herd at the New Jersey Experimer tion, observed that either the microbe had modif life habits to better suit the cow or the cow acq tolerance for the germ. At any rate, the cow her calf longer the second time and often carri full period the third time. But newly purchase were attacked with renwed violence and youn were more susceptible than old cows. One youn 1½ years old, aborted 2½ months after conceptio two cows, each 2 years old, aborted at 2 m while older cows aborted after the fifth month, a second year no cow aborted under 6 months.

Immunity.

This tendency on the part of the microbe a host to adjust themselves to each other result two or three abortions in a form of immunity. ever immunity in this case is not meant to conv idea that the cow is rid of the germs, but that sh ply will not abort again, while for a long peri germs remain in the womb and may be transmit susceptible animals.

Symptoms.—The first one or two months of nancy abortion occurs without labor pains or str and sometimes the fœtus lodges for a few hours vagina with portions of the fœtal membranes h from the vulva or the fœtus may be found in the or pasture. If these evidences pass unobserved, t charge from the vulva may be mistaken for hea if the cow refuses the bull then, and allows ser due course of time, the evidence, in connectio supposed previous pregnancy, though circumstan quite conclusive that abortion had occurred. I

infectious cases are traced to some misfortune or
dent. But cases caused by infection, not being ex-
ed, more frequently pass without due consideration.
ever, it may be a serious mistake to neglect such
s because of the danger of disseminating the dis-
. Though many have claimed that abortion seldom
rs before the fifth month, the contrary is quite
able, but, being of apparently little consequence,
ot taken into account.

eferring again to Nelson's experience, four cows
osed to be pregnant required service again, and
tion was suspected, though no expelled fœtus was
d. This supposition was strengthened by the fact
these cows had already aborted or did abort later.
e last half of pregnancy the symptoms are more
ked and the consequences more grave.

ne, two or three days before delivery the ligaments
x, the flanks sink, the vulva enlarges, and the milk
a colostrum-like appearance. The discharge from
vagina is less thansparent than normal—yellowish
in cows and white in mares. Labor pains precede
very. The animal walks around in a circle, looks at
side, lies down and gets up again; strains; and the
s is expelled.

he fœtal membranes pass out with the fœtus in the
y stages of pregnancy, but are liable to be retained
ng the last half. This not infrequently happens
r regular birth, but more is liable to occur after pre-
ure deliveries. The afterbirth may come away in
course of three or four days, and no further trouble
xperienced. Occasionally the placenta is retained
l it decays in the womb. The animal ceases to rum-
e, and eats sparingly and irregularly. She stands
e with the head down, or occasionally turns to look
he side. She is dull, weak and listless. The dis-

charge from the vulva may be profuse or slight watery and carries more or less decayed tissue, ing it heavily turbid and giving a dirty, nasty a ance, and an offensive odor. The tail is soiled putrid discharge. Frequent efforts are made to u The animal becomes lean and bony (emaciated may linger weeks in this condition. The syster cast off the putrid matter, and the cow recover the condition grows worse, she grows weaker and until death. Less frequently the animal dies from poison.

Prolapsus of the uterus or inversion of the w sometimes a sequel to abortion. Inversion of the is recognized by a tumor-like mass projecting fr vulva, moist and red at first, but becoming dark— black—and dry after long exposure.

TREATMENT.—Retention of the afterbirth (pla and inversion of the womb occur so frequently i nection with abortion that it is deemed advisable clude these accidents in the treatment.

Where the womb is inverted, secure the cow in row stall; wash with 2 per cent. creolin solutic with vaseline or lard and when the cow is not str replace by pressing against the mass with the of the open hands. If the effort is not successful the womb is inverted again as often as replaced, the assistance of a surgeon or some one who has h perience with such cases.

An afterbirth retained longer than three or fou should be removed by manual effort. Secure the in a narrow, open stall.

The arm bare to the shoulder, is washed in 2 pe creolin solution and introduced. The os ute will be found dilated as long as the afterbirth r

nnected with the womb, and should the afterbirth de-
y in the womb, the os uteri will remain sufficiently
en to admit a man's hand long after delivery. (If all
e fœtal membrane is expelled when the calf is born
e os will close in one to three days.) Whatever parts
the afterbirth protrudes from the vulva is grasped by
e free hand and gently pulled while the hand in the
omb traces the membrane to its attachments and each
tachment is separated by teasing with the ends of the
gers.

In neglected cases where the afterbirth has decayed,
e membrane will be found in a semi-fluid state collected
the deepest cavities of an apparently paralyzed womb.
e putrid content is scraped or scooped out with the
nd, fingers kept close together and bent half way to
lm.

Fig. 13.—A womb irrigator that may be used by connecting it to a fountain syringe.

The womb is flushed, with 2 per cent creolin solution,
d again scooped out and the process repeated until the
omb is clean. Creolin solution may be introduced by
eans of an ordinary fountain or rubber bulb syringe
ith a long rubber discharge tube, the free end being
rried arm's length into the womb by the hand.

PREVENTION.—Referring now to the disease proper
evention is urged as the only economical course to pur-
e. Enough has already been said to imply that the in-
ction once introduced will baffle the most careful effort
effect its destruction. Some of the principle means
which the disease is distributed have been detailed

and it is not necessary to refer to the subject agai
cept to urge that no animal be purchased from any
where the disease prevails, or has been known to
in enzootic or epizootic form. Equal care should b
ercised over the bull's patronage where the disea
suspected in the vicinity.

After the disease has appeared in the herd the aff
animals should be isolated, at any rate given a sp
corner in the barn to themselves. And immediately
the bull serves an infected cow the penis and pre
should be thoroughly disinfected.

The different methods of treatment have given u
tain results:

1. Efforts have been made to control the diseas
injecting small quantities of some antiseptic, like
bolic acid, under the skin at long or short interval
by requiring the animal to consume such remedies
the food. But it is quite probable the only good ac
plished was to satisfy the owner until the affected
acquired immunity.

2. Flushing the womb with solutions of disinfect
have not been attended with the results expected.
sons who have applied these remedies with the gre
care and thoroughness have been surprised to see the
ease appear again in the subjects treated. We hav
ready considered the structure of the female gener
organs, and it is readily understood how the gern
habiting the deeper portions of the womb, cut off
the outer portion with the exception of a small ope
the os uteri (7), could escape the most thorough e
to apply remedies in such manner as to be efficient.

3. Attempts to stamp out the disease by mean
antiseptics has met with so little success that some
ers have recommended the slaughter of all animal
fected. Disposing of the animals with a view to

chasing new subjects is, however, an unsatisfactory practice. All experience goes to prove this. For example, Mörck refers to a herd where the animals were sold off as they aborted and new ones purchased to take the place for a period of eight years without improvement. The owner then resolved to keep the animals at all hazards, and within two years abortion disappeared from the herd. This method would be practicable where the owner is prepared to sacrifice all exposed animals for slaughter and begin business with new stock and in different quarters. A cow, it matters not how valuable her milking qualities, should never be sold for breeding purposes if she is suspected of having infectious abortion.

4. There is another recourse for the breeder; he can establish immunity in his herd. This will, perhaps, entail the loss of two or three calves, for each cow, and a reduction of milk during as many periods of lactation, but, after all, it is doubtles the most economical course to pursue.

In making up a forecast for a line of treatment we are reminded that cows which miss one calving period and abort before the next or those which carry almost full time, often give a full flow of milk, seeming to suffer no inconvenience from the mishap. Also the number of living calves delivered by aborting cows implies that it may be possible to bring the infected cow to the full period of pregnancy, thereby securing a viable calf. Then, presupposing irritation, as previously intimated, to be the active cause of abortion, the first object of treatment should be to tide animals which show signs of aborting over the crisis by giving anodynes. Such a course of treatment gave highly satisfactory results at the Vermont Experiment Station. After four abortions had occurred three out of nine other cows pregnant, showed signs of aborting, but the act was pre-

vented by the administration of laudanum and all t
animals delivered without accident at the proper ti
These animals were kept under the influence of the dr
two weeks. Pulverized opium or laudanum may be us
For the cow the powder may be given in 2 or 3 drac
doses, or the laudanum in wine glass doses six ho
apart. To counteract the tendency of the opium to c
stipate the animal one-fourth pound of Epsom salts n
be given in the feed or as a drench dissolved in wa
twice a day. Fluid extract of Indian hemp is a bet
remedy, if a reliable quality of the drug can be had.
effect endures longer and it also has the advantage
not interfering with the action of the bowels. The d
is one fluid ounce two or three times a day. In eit
case the remedy should be given several days, and wee
if necessary.

If by this means cows can be rendered immune wi
out ill effects upon the animal or loss of calf or m
product to the owner, all will be accomplished t
could be expected.

Much can be done to prevent the spread of infect
by disinfecting infected cows and bulls and premi
occupied by such animals. As a matter of fact tre
ment is not complete without the general use of dis
fectants. There is a bare posibility of freeing the a
mal of infection if the case be taken in hand immediat
after delivery before the os uteri (7) has closed. T
the deeper parts of the womb (8) may be irrigated w
the solution to be used.

Creolin or lysol in the proportion of 1 part to 50
water is preferable for flushing out the womb. Eit
solution may be left in the womb with little dang
since neither drug is poisonous. However, if the ani
does not eject the surplus fluid, which usually happ
within half an hour, it may be well to wash out

womb with water which has been boiled and cooled These applications should be made two or three times a day while the os uteri (7) remains open, but after the os closes the application once a day should be continued for ten days.

Other antiseptic solutions, as carbolic acid 1 to 40 parts water, or corrosive sublimate 1 to 3,000 or 1 to 5,000 parts water, may be used, but requires to be washed out in a very short time because of the poisonous nature of the drugs.

The tail and other parts near the vulva should be frequently cleaned with the antiseptic solution employed.

An ordinary fountain or a rubber bulb syringe may be used for injecting solutions. The nozzle should be carried arm's length into the womb.

To disinfect bulls the nozzle of the syringe is introduced into the prepuce, and the fore-skin is held tightly about the nozzle until the cavity flows full. The practice of irrigating the genital organs with antiseptic solutions just prior to service is not to be encouraged, since conception is very uncertain after such applications. Every precaution should be taken to disinfect premises occupied by aborting animals. All dead fœtuses and membranes should be burned or enveloped in quicklime and burned.

Litter in the stall where abortion occurs should be piled up in a corner, or, better, shoveled into a box and mixed with milk of lime (1 measure of freshly slaked lime with 2 measures of water). Mop the stalls with bluestone solution (4 pounds bluestone, 4 pounds fresh lime, dissolved in 40 gallons of water), and whitewash as soon as dry.

Abortion occurring in cows which have been purchased from herds the reputation of which are not known should arouse suspicion and be isolated from other ani-

mals, and not allowed service by a bull kept for gene use. Some young or old bull ready for castration m be used to test such cows.

MILK FEVER.

Dropping After Calving.—Parturiant Fever.

Cause.—The cause is unknown.

Opinions on this part of the subject are very numer and varied. Some claim the disease is caused by growth of bacteria in the udder or the elaboration bacterial products which are absorbed into the circu tion. Others hold that it is due to a bloodless condit of the brain or, on the the contrary, to the congest of the brain.

The view once held that the shock at the time calving could be responsible for the disorder is har tenable, since it seldom, if ever, occurs in connect with difficult parturition. More recent investigat have turned their attention to the modification of blood, finding it extremely rich and dense, so dense fact, that the red blood corpuscles are reduced fu one-half normal size. Whether this is due to the blo being surcharged with albuminous and fatty matt stored up for the formation of colostrum or first mi failing to be excreted by the udder, or whether the c rent of nutrition intended for the fœtus failing to fi its way out through the usual channel, reacts on system through the blood, has not been determined.

Another line of argument purports to establish theory that toxic products are produced in the wo and absorbed, leading to a form of intoxication. T arguments adduced are interesting. The fact is point out that the os uteri or neck of the womb (7) is op

ı long period of time before the expulsion of the thus admitting infection and allowing time for velopment of poisonous products. The absorption se products is facilitated by the absence of a al placenta in the cow to which the disease seems ır. The parts are retracted and the blood irreg- distributed in the womb and intestines. This in tion with the presence in the womb of a profuse nt and semi-solid gelatinuous mucoid substance, cent in appearance and far less ropy than the nd liquid discharge after normal delivery partic- favors this idea.

matter of fact calving is an essential condition; sease never appears except in connection with , usually one or two or three days after that act, rare instances, may occur a few hours before- Two other conditions, less essential, but quite stant, should be mentioned. First, the cow is always a deep milker and in full flesh. Second, ease occurs in mature cows seldom earlier than rd calving, and when delivery is easy. More or sorder of the digestive organs always accompany ease, but this is probably secondary, though some hought this a source of a part, at least, of pri- ause.

reeds are subject to the malady, but the leading reeds, Jerseys, Holsteins, Geurnseys and Ayer- are the most frequent victims.

nimal which has once suffered with the disease e to have it recur at the next calving.

PTOMS.—The cow calves with ease, in most in- the afterbirth (placenta) is passed with the calf. period of time varying from a few hours to three rely four days, the cow is in apparently good Then, if the first signs are noticed, the cow

looks anxiously after the calf; the gate is unsteac
knees appear weak and the hind quarters rock fro
to side, and the hind feet are awkardly lifted a
placed one after another in order to regain equil
This is the treading act sometimes noticed. The ta
swings back and forth, following the motion of th
The temperature is now 102-103°, the normal bein
Pulse only slightly accelerated, full strong and r

In the course of half an hour the cow staggers, b
walks blindly against objects, and, at times, t
mount the manger. The hind feet are lifted hi
awkardly, apearing to strike at the abdomen
stumbles over objects and falls completely or o
the knees, but rises again. The eyes wander,
wild and glassy or peculiarly lusterless, the ra
pear to be reflected rather than transmitted. Th
hangs pendant from the withers and is dispo
swing far to one or the other side. The animal se
lose her balance and falls; falls with the limbs sp
as if under the influence of an intoxicant. She
unable to rise again to her feet, but at times, seem
recover, momentarily from a torpor, an effort is
to rise. The result is characteristic. The cow co
her knees, but the effort of the hind limbs to b
the posterior part of the body overbalances the
brum at the front and the cow tumbles a half leng
ward. The pulse is now rapid, weak and irregula
perature uncertain, but may be 103-105°; head and
are said to be hot; membranes of the eye red and
flow freely. The sphincter muscles at the anus re
heat radiates from the part and rectal temperatu
come less and less reliable.

After a varying period the torpor passes into co
coma. The cow lies on her breast with her head

around to one side, the muzzle resting on the ground. This position illustrated in figure 14 is a characteristic

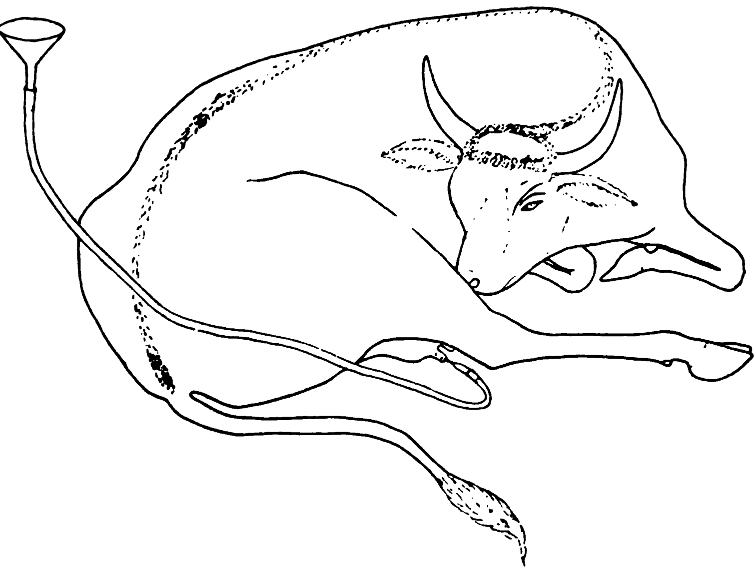

Fig. 14.—Characteristic position of cow in comatose condition. Funnel, rubber tube and milk-tube arranged for injecting Schmidt's solution.

symptom. Or the animal may stretch broadside upon the ground. While in this position the paunch (rumen) is more elevated than the head and fluids from the paunch flow to the head. About one gill of green fluid carrying particles of masticated food in suspension collect in the uppermost nostril. The presence of this fluid accounts for the rattling, gurgling sound which now accompany breathing. The muscular tissue of the gullet (œsophagus) is paralyzed. So, also, are the muscles of the voice box (larynx). Thus, when the head rests on a plane lower than the paunch liquids may

gravitate unhindered to the head, collect in the nose a
when the head is raised, which occurs periodically, t
fluid flows back to the pharynx, thence between t
paralyzed vocal cords and down the wind pipe to t
lungs. Ordinarily this would cause violent coughi
but the cow is not now capable of the act. However,
fatal cases, when the wind pipe is opened after dea
particles of food are found adhering to the surface
the inflamed mucous membrane. The rattling, gurgli
sounds just referred to should be distinguished fr
sonouous vocal sounds emitted by animals when no flu
have been allowed to come in contact with the vo
cords. These sounds are low and moaning, and are d
to the vibrations of the relaxed vocal cords during
piration.

Sensibility has disappeared, the animal no longer
sponds to pin pricks. A better test for the comat
state, however, is to place the finger on the eyeball:
the eyelids do not close the animal is insensible. R
pirations are slow and indicate deep sleep. Tempe
ture normal or below normal.

Course—The disease appears one, two and rarely thr
or four days after delivery. The sooner the more serio
will be the consequences.

Taking a case of average severity, the couse will
about as follows: One-half hour after the first sym
toms, which are seldom observed, appear, the cow
staggering, bellowing and falling; a half to one ho
later she is down, but able to make efforts to rise; o
to three hours she lies in a semi-conscious conditi
then passes into a state of coma. In order to t
whether the cow is conscious offer to put the finger
the eye, if the eye is not sensitive to the touch, the com
tose stage is reached. Coma persists six to fifteen hou
in favorable cases, or in fatal cases, until death, whi

anspires from one to four days after the first symp-
ms are noted.

TREATMENT—All cows which are heavy milkers and in
od flesh, especially cows which have suffered an attack
 milk fever, should have the feed reduced, or, what is
tter, be turned out to find a living on scant pastures.
ean cows are seldom (if ever) attacked, therefore an ef-
rt shauld be made to reduce the cow's flesh as a pre-
entative measure. Some regime of exercise on a
duced food supply should begin not less than two
eeks, and longer, if possible, before the cow is due to
liver. The practice of giving a purgative when the
w begins to spring is of questionable utility, if not
jectionable. It is not a good practice to give purga-
ves to heavily pregnant animals. Three courses of
edicinal treatment are admissible and attended with
rying degrees of success.

1. Give a purgative while the cow is conscious, but
 all means never administer drenches after the ani-
al is unable to hold up the head. Medicines are then
able to go down the wind pipe, causing pneumonia and
ath.

During the comatose stage the animal must be kept
aced in a normal position . This is one of the most
portant features of treatment, and should be executed
en if it is necessary to watch over the animal day and
ght. Bags filled with straw or cotton-seed hulls are
ry convenient for bracing the animal on the breast.
 she lies stretched upon the side, bags should be used
 elevate the head as high as the highest part of the
dy.

For a good purgative use Epsom salts 1 pound, com-
on table salt ½ pound, ground ginger 1 ounce, and aloes
ounce. Mix in two quarts of water; shake and drench.

Drench always through the mouth and never th
the nostrils.

2. The second course of treatment aims at the
result, *i. e.,* to empty the bowels, but has the adva
of avoiding the dangers of giving drenches. Divid
grains of eserine sulphate in three parts, dissolve
part in a little water and inject into the wind p
half hour intervals by means of a hypodermic sy
Repeat in twenty-four (24) hours if the animal
no signs of recovery. This course is attended with
erate success.

3. The third course is that of Schmidt. This
far the safest and most successful treatment know
per cent. of cases are said to recover.

Dissolve 2 drachms of iodide of potash in one
of water which has been boiled and cooled to blood
Inject one-fourth of the solution into each teat
milking out thoroughly. Leave this in the udd
hours; milk out and repeat if the animal shows no
of improvement.

A funnel, rubber tube 3 to 5 feet long, and milk
connected as illustrated in Fig. 14, may be used f
jecting the solution. The milk tube is inserted in
teat and some of the solution is poured into the
by an assistant. If the liquid refuses to flow a
compress the rubber tube a few times in the hand.
will force out some of the air and start the flow.
milk tube cannot be secured, almost any druggis
make a tube that will serve by heating a glass
suitable size in an alcohol flame and drawing it
the proper proportions. Then the broken ends
glass are rounded in the flame.

A rubber bulb or fountain syringe may be us
stead of a funnel. All vessels and apparatus to b

ecting medicine should be thoroughly disinfected ing water before use.

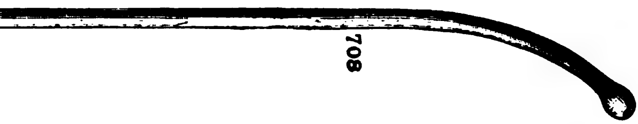

Fig. 15.—Female catheter.

e think it advisable to introduce the hand into omb, remove the mucous and portions of placenta nay have been retained, and irrigate the womb ; per cent. creolin, or some other suitable anti- solution. The foregoing courses of treatment be supplemented by one-half grain doses of nine given hypodermically, or one grain doses in capsules on the root of the tongue every three r hours. Keep the animal braced in a normal po- or the head elevated and expect recovery in 15 to urs.

some instances the animal suffers with debility recovery from the acute attack. The writer's ex- ce with such cases is limited, but usually the l eats sparingly, digestion is impaired, and the nent softer than normal, and lacking color. If is no improvement, death occurs in the course of wo or three weeks.

ne animals never fully overcome the effects of ack of milk fever. This is manifested by the re- n in milk flow. In order to ascertain approxi- y the amount of permanent injury sustained from fever, questions were addressed to four parties at random, whose cows had been successfully d with Schmdt's remedy.

L. H.: Has your cow given as much milk since ad milk fever, and how much has been the reduc-

s. "My cow does not give as much as before the

attack. She gave a little more than three gall
since she has given but little more than two
and I have never been able to get her above
one-half gallons per day."

Mr. J. T.: "My cow has had two attacks, the
vere, and the second very mild. There was a r
of one-half gallon in the milk flow after the
tack, but have not noticed any reduction after
ond."

Mr. S. T.: "My cow has her third calf. Ne
months ago she suffered a severe attack of mi
The milk yield is now nearly three gallons
which is better than at any time in her previous

Mr. W.: "My cow suffered a severe attack of
ver about one month ago. She is 10 or 12 ye
She improved rapidly and as evidence that he
is unimpaired she has a ravenous appetite. S
as much milk as ever, about 3 1-2 gallons, witho
feed."

These animals were treated by the writer o
A. Cary, and we testify that the cases were
milk fever or parturient apoplexy of a seve
Each animal passed through a stage of comple
lasting for several hours.

INFLAMMATION OF THE UDDER—GARGET—MAM MASTITIS.

The udder of the cow is divided into four
glands or portions, with complete partitions, i.
quarter is not connected with another.

Prominent among the causes are imperfect
allowing some of the milk to remain in the udde
becomes infected, curdles, begins to decompose,
flammation follows.

Heavy milkers are most frequently attacke

remely easy and extremely difficulty milkers are
qually liable. Hard milkers because these are
nore liable to be imperfectly milked; easy milkers
ecause a drop of milk is often carried suspended to the
oint of the teat, which, becoming infected, infects the
nilk within the udder. Milk is an ideal medium for the
rowth of bacteria. Injuries to the udder, like kicks,
lows, etc., and even the calf punching the bag while
ucking, are claimed to cause the disease.

Symptoms.

The bag is swollen, feverish, painful, and red with
ongested blood. Milk flow is reduced, and the milk is
hanged in appearance and character. The milk is
umpy or watery and may be tinged with blood. As
he disease progresses it assumes the appearance of
vhey, containing shreds or floccules of solid matter. In
ome cases there is little flow or none from the teat, the
ag becomes hard and unyielding, if a hind quarter the
nflammation extends far up toward the vulva.

Pus or matter may form and decay progress till the
ffected quarter literally rots out or if inflammation is
imited the pus may be discharged, the bag softens and
ecovery follows, though the power of the gland to se-
rete milk may be permanently diminished. Often the
liseased products are not cast off through the teat, but
n abscess forms between the teats or to one side of the
ag, and opens. Pus in varying quantities discharge
nd stringy, ragged particles of decayed tissue may be
rawn out. Such cases are prone to recover after appar-
ntly successful treatment.

Treatment.

Prevention: Milk cows with new-born calves, espec-
ally heavy milkers, not less than four times a day for

a few days after delivery. Forbid the filthy practi moistening the teat with milk before milking. A no filth from the bedding or portions of the after-t to adhere to the udder or to the legs near the u Provide clean stables and clean bedding. Cleanli in all probability, is the best preventative.

Remedial: Treatment is systemic and local. Dr the animal at once with the following: Epsom sal lb., common table salt, 1-2 lb., powdered ginger 1 powdered belladonna (roots or leaves) 1-2 oz., m with two quarts of water. Supply abundance of cool water.

Begin local treatment by injecting into each tea pint of Schmidt's iodide of potash solution (potas iodide 2 drachms, water which has been boiled cooled, one quart.) After the first application i onece per day, 1-2 pint into the affected quarter on

Rub the affected part once each day with campho-p (a saturated solution of camphor gum in carbolic carbolic acid 1, camphor 3-5.) This medicine may b plied with the bare hands with perfect safety, a the remedy par excellence for external use in ga It relieves pain, and penetrating destroys infe and acting as a counter-irritant (a mild bliste softens the parts and hastens absorption of dis products.

A simple treatment for which much is claimed i application of water as hot as can be borne, at fre intervals, followed by glycerine, vaseline or smeared over the parts. Glycerine is to be prefe Empty the teats frequently by hand or by means milk tube, if necessary. (Fig. 10.)

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ALABAMA.

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute.

AUBURN.

A LEAF-CURL DISEASE OF OAKS.

With 1 plate and 3 text-figures.

E. MEAD WILCOX, Ph D. (Harvard).

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The Bulletins of this Station will be sent free to any citi the State on application to the Agricultural Experiment S Auburn, Alabama.

Plate 1.—Quercus nigra, one of the common shade trees in Alabama.

A LEAF-CURL DISEASE OF OAKS.

BY E. MEAD WILCOX.

ral of the native oaks are widely planted and prized in this State as shade trees both along city vn streets and about private dwellings. No small the beauty of a city or town is to be found in the and character of the shade trees along its streets. shade trees about private dwellings add much to neral appearance and attractiveness of the home ntribute largely to the comfort and pleasure of upants of the house. In fact, the general condi- the shade trees along the streets of any town may taken as a fairly accurate index of the prosper- l intelligence of the people of the community. of our people now appreciate the value of good rees and are desirous of protecting them against ir enemies. The purpose of the present bulletin ll attention to one of the fungus diseases of some r native oaks that threatens now to de- nany of these trees, particularly in our cities and If, incidentally, more interest is aroused in home y adornment through the agency of good shade useful purpose will have been accomplished in rection.

a pleasure to acknowledge here the kindness of ous correspondents in this and other States who nt the writer specimens and notes of great value. also to give expression here to my indebtedness N. L. Britton, Director-in-chief of the N. Y. Bo- ardens, and members of his staff, and Miss Jose- A. Clark, Librarian of the U. S. Department of ture, for many exceptional favors and helpful as- rendered in the consultation of the extensive lit- in their charge.

NATIVE OAKS USEFUL AS SHADE TREES IN THIS STA

The distribution over the state of the oaks tha most important for shade purposes in this state fo Quotation marks enclose the statements made in M Plant Life of Alabama regarding the special habi each of the species. The species are arranged alph cally by the scientific names.

SCARLET OAK. *Quercus coccinea* Muench).- well known oak is frequent in the mountain regi "dry uplands, sandy and rocky soil."

LAUREL OAK. (*Quercus laurifolia* Michx— species occurs over the southern half of the state most characteristic of the central pine belt and the plain. It occurs in "low rich woods." This is c our most highly prized shade trees on account of its green foliage.

WATER OAK. (*Quercus nigra* L.)—This c rather common from the Tennessee river valley sou the coast occurring naturally in "low rich woods sandy pine-barren swamps." This tree is very v planted as a shade tree in every part of the state.

WILLOW OAK. (*Quercus phellos* L.)—This s is found from the Tennessee river valley southwa the central pine belt of the state but is not comm the southern half of the state. It occurs "in the b lands, borders of swamps. Most frequent in the co the Tennessee basin in low woods of a cold damp This is also widely planted as a shade tree and in towns practically to the exclusion of all other oa

BLACK OAK OR QUERCITRON OAK. (*Qu velutina* Lam.)—This species occurs from the Ten

river valley south to the upper portion of the coast pine belt. The bark is the so-called "quercitron bark" employed for tanning and as a dyestuff while the timber is of some value.

LIVE OAK. (*Quercus virginiana* Mill.)—This oak occurs only in the coast plain district and rarely extends north of about 31°. This, one of the valuable timber and tanning trees of the state, is at times in the coast plain counties a very important shade tree.

SYMPTOMS OF THE DISEASE.

The disease now under consideration makes its appearance early in the spring before the new leaves are mature. A number of grey or bluish spots appear on the leaf and the more rapid growth of the parenchyma of the leaf at these points renders the surface convex on one side and concave on the other. The concave side of this spot or area is frequently on the upper side of the leaf but the spots on the same leaf may show variation in this regard. Some trees have been seen in which the great majority of the concavities were upon the lower surface but this is by no means the rule. These characteristic depressions, or "pockets," in the leaf result from the more rapid growth set up in that part of the leaf by the presence and action of the fungus causing the disease. These areas vary in diameter from 0.25 to 1 cm and are either isolated or confluent. In some of the narrow leaved oaks, such as *Quercus phellos* and *laurifolia,* it is not rare to find the spots confluent over so large a part of the whole leaf that the leaf is as badly curled as occurs in the peach leaf-curl, a closely related disease.

The rapid spread of the disease from one leaf to another may lead to a partial or even complete defoliation

of the tree in early summer. However serious the o
break of the disease and the resulting defoliation may
the tree generally attempts by the formation of n
leaves to compensate itself for the foliage lost. In
treme cases of defoliation it is not uncommon to se
tree with an entirely new foliage covering in midsu
mer. In most cases the second growth of leaves is not
badly injured by the disease as was the first and it m
entirely escape the attacks of the disease.

It is plain therefore from what has been said that
general effect of the disease upon the tree is much
same as defoliation due to any other cause. The eff
of such a disease upon the life of the tree may best be
preciated when one recalls the fact that one of the m
important functions of the leaves is to elaborate witl
their tissues the food material for use by the various pa
of the plant in the building up of new tissues and otl
purposes. Even the roots are dependent upon the lea
for the food required for their growth and the defoliati
of the tree may result in the most serious damage to
root system of the plant. Defoliation may result also
the great reduction of the growth in diameter
the stem, and particularly in the reduction in the amou
of reserve food material stored up in stems, roots a
buds for the following year's growth.

The second growth of leaves results from the prolep
development of buds intended for the following yea
growth. And since, as just stated, these buds have h
stored in them less food than usual owing to the d
eased condition of the foliage of the tree, it is natu
that the second growth of leaves developing from th
should not be so luxuriant as was the first leaf coveri
of the tree. Under such conditions, therefore, the tr
enters upon the second year's growth with a very sm
supply of reserve food material. The cumulative effe
of the disease may therefore result in many cases in t
death of the tree from actual starvation. It is very ra

however that the most severe attack of the disease will result in the death of the tree during the first year.

FUNGUS CAUSING THE DISEASE.

The fungus causing this disease is one of the lower *Ascomycetes,* a group characterized by the formation of its spores in small sacs of "asci," singular "ascus." This fungus is very closely related to the *Exoascus deformans* causing the well known leaf-curl disease of peaches. Unlike the latter our fungus does not possess a perennial mycelium and is carried over from one year to another entirely through the agency of the ascospores. These germinate in the spring and form a mycelium that spreads out beneath the cuticle of the leaves of the host to form there a more or less extensive network of hyphæ. From this vegetative mycelium the asci arise in large numbers. These are more or less cylindrical in form and are packed closely together side by side. See Fig. 1.

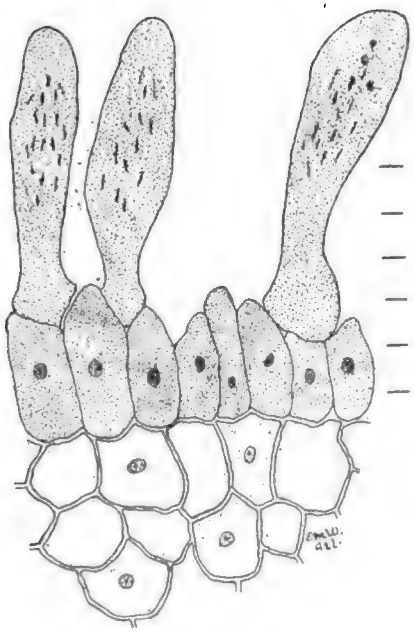


Fig. 1.—Cross section of a portion of a diseased leaf, showing the young asci of the fungus. Each division of the scale is equivalent to 10 mu.

The asci arise between the epidermal cells and th
cuticle and break through the cuticle toward matur

Each ascus contains at maturity a large numb
small spores though it is probable that in younger
the typical condition is the 8-spored ascus. These or
8 spores however multiply to a large extent within t
cus resulting in the much larger number that is
found in the mature asci. The asci in the materi
have examined are from 50 to 75 mu long and from
25 mu wide. The spores measured vary from 1.5
mu in diameter.

As has been mentioned in the discussion of the sy
moloy of the disease, the asci arise in small rou
areas upon the surface of the leaf. In the origin
scription of this fungus Desmazieres states tha
spots arise on the lower surface of the leaf but t
certainy not uniformly the case. We have
ticed that in *Quercus velutina,* the black oak, the
are generally upon the lower surface only. The sam
is recorded for this species by Robinson 1887. In
cus nigra, the water oak, and some other species the
occur on both the lower and upper surfaces of the l
In all the species examined these spots are at first r
definite but sooner or later several of the spots fu
gether so that the spore bearing areas became ve
definite and large.

Like many of the fungi the species under consider
has been referred to under a rather large numb
names in the past. Desmazieres in 1848 publishe
new genus *Ascomyces* Mont. & Desm. to include th
gle new species *Ascomyces coerulescens* Mont. & I
But the genus *Taphria* had been established by Fr
1815 who assigned to it but one species, *Taphria pop*
now known as *Taphria aurea.* Fries in
however, complicated matters by altering his

hed name *Taphria* to *Taphrina,* to avoid, as he at the time, confusion with Taphria a genus of s. Tulasne in 1866 revised the genus *Taphrina* of and made it include also the species of *Exoascus.* son followed Tulasne and Johanson also in ing all the species of the genera *Ascomyces* and *ina* and *Exoascus* in the genus *Taphrina*, as ex- l by Tulasne.

ny judgment the plan followed by Schroeter 1894, ing up the original genus *Taphria* Fries is by far est and is in accord with present practices. eter assigns to this genus all those spe- hose asci at maturity are multisporic and to the *Exoascus Fuckel* he assigns all those species whose t maturity are 8, or rarely 4, spored. In accord- ith the above statements our species shold be writ- *phria coerulescens* (Mont. & Desm.) Schroeter, and llowing would be its synonomy:

Ascomyces coerulescens Mont. & Desm. 1848.
Taphrina coerulescens (Mont. & Desm.) Tulasne. 1866.
Ascomyces quercus Cooke. 1878.
Ascomyces alutaceus Von Thuemen. 1879.
Exoascus coerulscens (Mont. & Desm.) Sadebeck. 1887.
Taphria coerulescens (Mont. & Desm.) Schroeter, 1894.

PREVENTION OF THE DISEASE.

fungus causing the disease now under considera- an annual and its mycelium does not perennate the tissues of the host as is true of many of the related forms, such as the peach leaf-curl fun- The treatment of such fungi is very much more carried out than is the case with perennial fungi,

a portion of whose mycelium lives over winter
the host plant itself. In fact in the case of the p
lar fungus causing this disease no part of the my
enters the host plant farther than directly benea
cuticle of the leaf.

During the spring of 1902 an attempt was made
vent the appearance of the disease upon a specir
the water oak, *Quercus nigra.* The ordinary Bo
mixture was employed, made according to the fol
formula:

Copper sulfat or "blue vitrol"....	4 lbs.
Unslaked lime	4 lbs.
Water	50 gallo

Place the copper in a coarse cloth sack and d
it by suspending the sack in a wooden vessel h
about 15 gallons of water. The lime is then to be
with just enough water to ensure thorough slakin
slaked lime is then to be made into a paste havi
consistency of thick cream by adding water and st
When the solutions thus prepared are cold th
water is to be poured into the copper sulfat s
through a fine sieve. Water is then to be added t
the solution up to the required 50 gallons and the
thoroughly stirred before and while using. If to
lime has been employed the solution may injure
foliage and the potassium ferryconaid test should
plied to determine this point. The test consists i
ing to a small sample of the prepared mixture
drops of a solution of potassium ferrocyanid ma
adding one part by weight of the salt to five parts
er. If, upon the addition of a few drops of this so
the bordeaux mixture becomes a reddish-brown or
know that not enough lime has been employed in th
aration of the spraying solution. After the addi
more lime test again in the same manner and co

ne solution ready to use only when no discoloration ap-
ears after the addition of a few drops of the test solu-
on to a small sample of the spraying mixture.

The tree employed in our experiment was thoroughly
prayed about ten days before the buds opened and then
t intervals of ten days three more sprayings were given.
he dates were as follows: February 26, March 9, March
8, and March 26. Of course the first and all subsequent
ates must be determined by the advancement of the sea-
on. Although the sprayed tree was in close proximity
unsprayed trees of the same species that were badly
njured by the disease, the sprayed tree was only very
ightly affected by the disease. More extensive experi-
ents must be undertaken before one could say with any
ertainty that this line of treatment will in all cases be
ffectual in preventing the outbreak of this disease. But
e one positive demonstration of the value of this treat-
ent renders it very probable that the disease may be
eld in check by such treatment as that outlined above.
: is expected that further experiments along this line
ill be undertaken during the coming spring with several
pecies of oaks that are known to have had this disease
uring the present season.

HOST INDEX OF THE FUNGUS.

The fungus now under consideration has been reported
s occurring on the following species of oaks in the
ates named.

Quercus alba L. White Oak. Conn. N. J.

Quercus brevifolia (Lam.) Sargent. Blue Jack. Ala.
Car.

Quercus coccinea Muench. N. J. Wisc.

Quercus digitata (Marsh.) Sudworth. Spanish Oak.
la.

Quercus laurifolia Michx. Laurel Oak. Fla.
Quercus marylandica Muench. Black Jack. Ala.
Quercus minor (Marsh.) Sargent. Ala.
Quercus nigra L. Water Oak. Ala. Fla.
Quercus phellos L. Willow Oak. Ala. Fla.
Quercus rubra L. Red Oak. N. H. N. Y.

GEOGRAPHICAL DISTRIBUTION OF THE DISEAS

The distribution of this disease by states is sh
Figure 2.

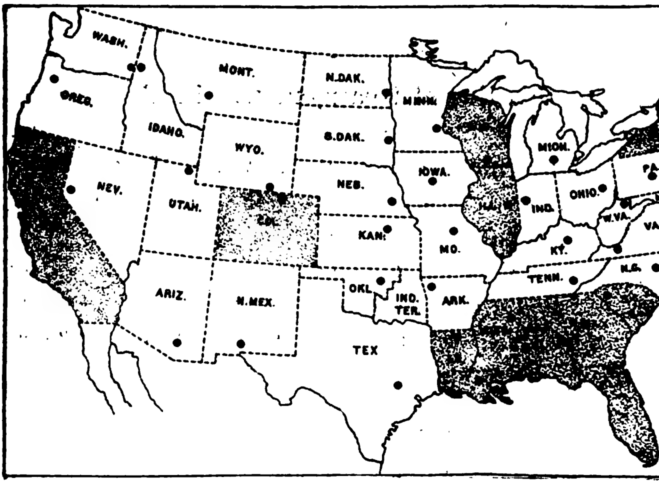
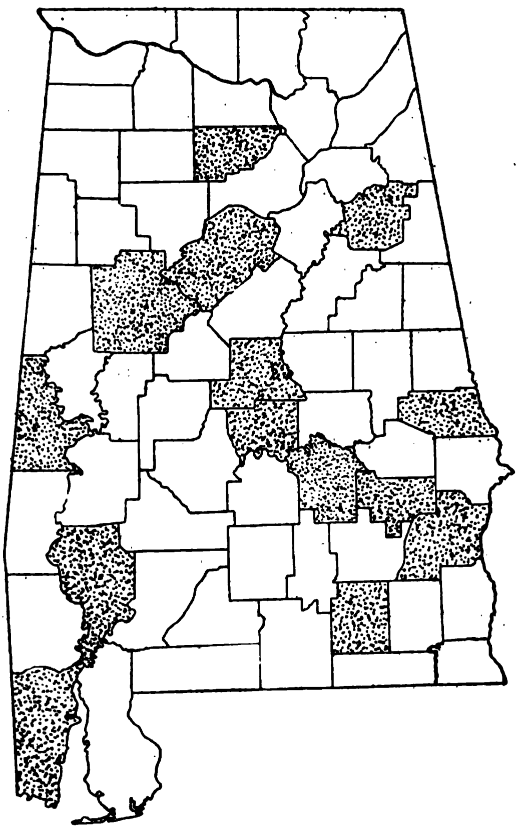


Fig. 2.—The disease described in this Bulletin is known to ent in the states shaded.

It is very likely that the particular fungus caus disease herein considered is found outside of th there indicated but serious outbreaks of the are to be expected only in the gulf states. It wo pear that the climatic and other conditions are region more favorable to the development of the

ıan those prevailing to the north and west. Specimens f leaves showing the disease and the fungus herein decribed have been examined by the writer from the folwing States: Alabama, California, Colorado, Connectiut, Florida, Georgia, Illinois, Louisiana, Massachusetts, Iississippi, New Hampshire, New Jersey, New York, Rhode Island, South Carolina and Wisconsin.



ig. 3.—The disease described in this Bulletin is known to be present in the counties shaded.

In figure 3 is shown the local distribution of th
ease in this State by counties so far as the write
been able to examine material. The disease no
does much damage in every county of the State bu
ticularly in the counties south of the Tennessee
valley. Material of the disease has been examined
the following counties: Autauga, Barbour, Bulloch
houn, Chilton, Clarke, Coffee, Cullman, Jefferson
Mobile, Montgomery, Sumter and Tuscaloosa.

OTHER SPECIES CLOSELY RELATED TO TAPHRIA COERUL

The following notes upon related species describ
growing upon species of *Quercus* may be of interest

Ascomyces extensus Peck .1886. Reported on
of *Quercus macrocarpa* from New York s

Exoascus kruchii Vuillemin. 1891. This s
was found by Kruch in Italy upon leav
Quercus ilicis, and is by Schroeter referr
Taphria.

Ascomyces quercus Cooke. 1878. This was rep
by Cook in Rovenel's American Fungi
leaves of *Quercus cinera*. It is identical
rently with our *Taphria cocrulescens*.

Ascomyces rubro-brunneus Peck. 1887. This w
ported by Peck upon leaves of *Quercus* r

It is quite probable that all the above species belo
the genus *Taphria* but their specific standing we hav
determined with sufficient certainty to refer to the
ter in this connection.

BIBLIOGRAPHY.

The following bibliography contains a list of the
important books and articles consulted by the auth
the preparation of this bulletin. The titles are arra

etically with the year of publication printed di-
beneath the name of the author.

on, G. F.

397 Some Fungi from Alabama. Collected chiefly during the years 1889-1892. Bull. of the Cornell University 3:1-50. On page 13 *Taphrina coerulescens* is reported from Alabama upon *Quercus aquatica, cinerea, falcata obtusiloba, nigra* and *phellos.*

, M. C.

378 Ravenel's American Fungi. Grevillea 6:129-146. On page 142 is the original description o. *Ascomyces quercus* sp. n. This is reported from South Carolina upon leaves of *Quercus cinerea.*

, M. C.

383 North American Fungi. Grevillea 11:106-111. On page 106 are notes upon *Ascomyces quercus* Cooke.

zieres, J.—B. H.—J.

348 Dizieme notice sur les plantes cryptogames recemment decouvertes en France. Ann. Sci. Nat. Bot. III,10:342-361. On pages 345-346 he establishes the new genus *Ascomyces* Mont. et Desm. to hold *Ascomyces coerulescens* Mont. et Desm. sp. n.

E.

315 Observationes Mycologicæ. 1:217. On the page cited Fries gives the new genus *Taphria* Fr. and lists but a single species under it, ie "*Taphria populina*" on leaves of *Populus nigra, tremula* and *dilatata.* Fig 3 on plate 8 shows *Taphria populina.*

E.

325 System orbis vegetabilis. On page 317 he gives the generic name *Taphrina* which he substitutes

for the previously published name *Taphrin*
reason for so doing is stated to be to avoid
fusion with the genus of insects named Tap

Fries, E.
1829 Systema mycologicum. On pages 520-521
notes on *Taphrina* Fr.

Fries, E.
1849 Summa vegetabilium scandinaviæ seu en
ratio systematica et critica....2:518. On
page cited is a description of *Taphrina*
with *Taphrina populina* as the first menti
species.

Fuckel, L.
1860 Enumeratio Fungorum Nassoviæ. On pag
he gives a description of the new genus and
cies *Exoascus pruni*, and gives a figure o
same species in figure 26 on plate 1. Thi
tablishes the genus *Exoascus*.

Fuckel, L.
1869 Symbolæ Mycologicæ. Beitraege zur Kenn
der rheinischen Pilze. On page 252 he give
der the genus *Exoascus* Fuckel the follo
species: *pruni, deformans* and *alni*. Fu
here states his preference for separating
multispored species from the 8-spored, assig
the former to the genus *Ascomyces* and the
ter to the genus *Exoascus;* and his obje
to the inclusion of both genera in the one g
Taphrina as done by Tulasne in 1866.

Ikeno, S.
1903 Die Sporenbildung von Taphrina-Arten. F
92:1-31. pl. 1-3. fig. 1-2.

Johanson, C. J.
1885 Om svampslaegtet Taphrina och dithoer
svenska arter. Oefversigt af K. Vetens. A

Forhandl. 1885:29-47. pl. 1. Figures of the following species are given: *Taphrina borealis, carnea, nana, polyspora, potentillae* and *sadebeckii.*

nson, C. J.

1885 Studien ueber die Pilzgattung Taphrina. Bot. Centralbl. 33:222-223, 251-256, 284-287. The author reports *Taphrina coerulescens* in Sweden and Norway.

:h, O.

1890 Sopra un caso di deformazione (Scopazzo) der rami dell' Elce. Nota preliminare. Malpighia 4:424-430. Record of *Taphrina Quercus* on *ilicis* in Italy. This fungus was described as *Exoascus Kruchii* by Vuillemin in 1891.

erson, F. W.

1895 A study of North American parasitic Exoascaceæ. Bull. Lab. Nat. Hist. State Univ. Iowa 3^3:89-135, pl. 1-4.

:, C. H.

1886 Report of the Botanist in 39th Report of the Regents of the University of N. Y. On page 50 he describes the new species *Ascomyces extencus* on *Quercus macrocarpa.* Fig. 1-3 on plate 1 represent this species which Peck states is distinct from *Ascomyces quercus* in "the character of the spots and also the spores."

k, C. H.

1887 Report of the Botanist in the 40th Report of the New York State Museum of Nat. History for the year 1886. On page 67 he gives a description of the new species *Ascomyces rubrobrunneus* on Q. *rubra.*

Robinson, B. L.
1887 Notes on the Genus Taphrina. Annals of B
any 1:163-176.
Saccardo, P. A.
1880 Fungi dalmatici pauci ex herb. illustr. R.
Visiani additio uno alterove mycete ex agli
pannonia. Michelia 2:150-153. On page
is a description of *Ascomyces alutac*
Thuem. upon *Quercus robor.*
Saccardo, P. A.
1898 Sylloge Fungorum. 13: ....Host list
the species of Taphrina.
Sadebeck, R.
1887 Die Pilze (Winter) 1^2 :10. Sadebeck here
signs *Taphria coerulescens* to the genus *Exo*
cus.
Sadebeck, R.
1893 Die parasitischen Exoasceen. Eine Mo
graphie. Jahrb. d. Hamb. Wiss. Anst. 10^2 :1-1
pl. 1-3.
Sadebeck, R.
1895 Einige neue Beobachtungen und kritische
merkungen ueber die Exoasceæ. Ber. Deut. b
Gesell. 13:265-280. pl. 21.
Cchroeter, J.
1894 Protodiscineæ. Engler u. Prantl's Nat. Pfl
zenfam. 1^1:157-161. fig. 136, H and J.
Smith, W. G.
1894 Untersuchung der Morphologie und Anato
der durch Exoasceen verursachten Spross—u
Blatt—Deformationen. Forst. naturw. Zeitsc
3:420-427, 433-465, 473-482. 1 plate and 18 t
figures.
Thuemen. F. von.
1879 Zwei neue blattbewohnende Ascomyceten
Flora von Wien. Verh. d. K. K. Zool.—Bot.

sell. Wien 29:523-524. He describes as a new species *Ascomyces alutaceus* on *Quercus pubescens.*

ılasne, L. R.

1866 Super Friesiano Taphrinarum genere et...... Ann. Sci. Nat. Bot. V-5:222-136. He refers *Ascomyces coerulescens* of Mont. and Desm. to *Taphrina coerulescens.*

ıillemin, P.

1891 L'Exoascus Kruchii sp. nov. Rev. Mycol. 13: 141-142. This species was collected by Kruch in Italy and its effect upon *Quercus ilicis* described by him in 1890.

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ALABAMA.

gricultural Experiment Station

OF THE

Alabama Polytechnic Institute.

AUBURN.

Alfalfa in Alabama.

BY

J. F. DUGGAR, Director and Agriculturist.

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1904.

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The Bulletins of this Station will be sent free to any citizen the State on application to the Agricultural Experiment Stati Auburn, Alabama.

ALFALFA IN ALABAMA.

BY J. F. DUGGAR.

The present bulletin combines the results of experi-
nts made by this station and the experience of a num-
of farmers who have begun to grow alfalfa in differ-
parts of the State, as kindly furnished in correspond-
e with the writer. This is intended as a preliminary
ort. Extensive experiments on alfalfa in co-operation
h the United States Department of Agriculture were
lertaken by this station during the fall of 1903. It is
expectation to present those results, and others, in a
ure publication.

lfalfa, or lucern, (*Medicago sativa*), belongs to the
ily of plants that normally bear enlargements or tu-
cles on their roots, through which these plants are
e to take the introgen of the air. Alfalfa is a peren-
l, living for many years without reseeding. Great
nbers of buds put out from the old root each year as
n as the coldest portion of the winter is past.

)uring the first few months of its life alfalfa may be
arded as a tender plant, both as regards cold and
ught. After it has passed through its first summer,
lfa is extremely resistant both to cold and to drought.
he name lucern, which also is properly applied to al-
a, has led some men, unfamiliar with alfalfa and ac-
inted with sweet clover or melilotus, sometimes in-
rectly called lucern, to confuse the two plants. These

are much alike when young. Alfalfa is a much sn fine stemmed plant, having purple blossoms and a seed pod.

Alfalfa has, for many centuries, been an imp plant, especially in the warmer portions of E Above all other crops alfalfa may be credited wi foremost place in the development of the arid regi the United States. At no distant day it will dou assume important proportions in the agriculture o bama. On all soils suitable to it in this State, i doubtless become one of the principal foundatic which the live stock industry will be based.

USES.

Alfalfa is useful for hay making, for feeding gre soiling), for pasturage, and for the fertilization soil. Its most important use is as a hay plant. A yields more hay per acre than any other leguminou age plant. Indeed, in yield it has few superiors, so perhaps being the only one of importance in Ala and this falling far behind alfalfa in nutritive Alfalfa hay is much more nearly a complete food t the hay of Johnson grass, sorghum, crab grass, etc

The following table gives the composition of gree cured alfalfa, and for comparison the composition tain other forage plants, the chemical data being from Henry's "Feeds and Feeding" and from McB tables.

Pounds of food material in 100 *pounds of forage.*

	Protein or muscle-formers.	Starch, sugar, etc.	Fat, wax, etc.	Woody fiber.	Ash.	Water.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
falfa hay	14	43	2	25	7	9
ow pea hay...	17	42	2	20	8	11
hnson grass hay	7	46	2	29	6	10
ab grass hay	7.8	45	2	28	8	9.2
ured corn blades	6	36	1	22	5	30
rghum hay (verydry.)	4	37	3	24	4	28
een alfalfa	5	12	1	7	3	72
een rye	2.6	7	.6	12	2	75.8

The nutrients of most value are those in the first ree columns. An *average* quality of cowpea and of rghum hay is believed to be a little poorer, and corn ades (fodder) a little richer, than shown by the figures the table.

From the above table it will be seen that alfalfa is bout as rich as other hays and corn blades in starchy aterials and sugar, and about twice as rich in muscle-rming material. Alfalfa hay is about equal in composi-on to the best grades of cow pea hay, but is not so oarse. Alfalfa hay is suitable for horses, cattle of all ges, and sheep. It is sometimes used in the Southwest the exclusive food for farm teams, but it is generally dvisable for working animals to have some corn in ad-ition to alfalfa. However, the use of alfalfa hay greatly educes the amount of corn necessary to keep working

teams in condition. For six weeks last summer C
C. Webb, of Demopolis, Ala., fed all the mules on
his plantations on alfalfa alone. Although they w
work they kept in satisfactory condition. Alfal
has also been successfully used as part of the win
tion for hogs. Alfalfa hay is similar to melilotus
composition, but much more palatable. It is less
makes a better appearance, and, unlike melilotus
is salable.

As a soiling plant, alfalfa may be utilized thro
every portion of Alabama, since the small area nee
this purpose will enable the soil to be suitably m
or limed or otherwise brought into condition for i
cessful growth. The especial advantage of alfal
soiling is the early date at which it is available,
ing the only other practicable crop which may be
early in the season. Alfalfa remains green thro
the year except in December, January, and Februa
Central Alabama, alfalfa has been cut for food for
as early as March 11. In nutritive qualities, gr
falfa is decidedly superior to green rye, and is eate
relish by all farm stock and poultry.

Alfalfa is sometimes used as a pasture plant on s
which it is well adapted, but is too valuable for
soiling to justify its general use for pasturage, un
acreage in alfalfa is greater than is needed for ha
ing and soiling. Pasturage shortens the life of
falfa plant by enabling weeds to outgrow it, and by
ing the soil too closely around the crown and roo
also by the injury resulting from very close cont
grazing. Stock should never run on an alfalf
when the ground is wet or frozen, nor during th
year after the seed are sown. Cattle and sheep a
ject to bloat when grazing on alfalfa. It is safer
respect for horses, and perfectly safe for hogs.

can afford to graze cattle or sheep on alfalfa unless thoroughly informed in regard to all possible precautions for decreasing the amount of bloat and unless he has a surplus of alfalfa over and above that which he can use for hay and soiling. The principal precautions against bloat are (1) feeding dry food before cattle or sheep are first turned on alfalfa; (2) gradually lengthening the daily grazing period; (3) allowing stock grazing on alfalfa to have access at the same time to a pasture containing palatable grass.

Alfalfa makes an unrivaled pasture for hogs. One may conservatively estimate an acre of good alfalfa pasture as capable of supporting a sufficient number of hogs to weigh at least 1,000 pounds. This record has been greatly exceeded. F. D. Coburn says: "Ten young hogs per acre will not damage alfalfa, and should make 1,000 pounds of gain in a season, under ordinary conditions, without grain." While hogs make satisfactory and economical growth on green alfalfa alone, they more completely utilize this crop when a little corn is fed. Alfalfa used as a hog pasture, should be mowed whenever it becomes tall or coarse, to promote fresh tender growth. Rings in the hogs' noses are advisable to prevent destruction of alfalfa pastures by rooting. The young shoots on alfalfa remain green practically all winter in central Alabama.

Alfalfa has been made into silage with varying success. In our climate where we have frequent rains, the silo might prove a profitable means of utilizing cuttings of alfalfa too much injured by rains to make good hay, but still succulent.

In Alabama alfalfa should be uesd for soil-improvement only after it has outlived its usefulness as a food plant. Alfalfa greatly enriches the soil in nitrogen gathered from the air.

YIELDS OF ALFALFA HAY.

The following estimates of their yields of alfalfa obtained are reported in correspondence by the par named below:

Total no. tons. per acre.	No. cuttings.	Reported by	County.	1st cu
3 unmanured 5 to 6 manured	4 to 7	J. C. Webb	Marengo	....
4 to 5	4 to 5	J. I. Thornton	Greene	May
1½ medium land 5 on bottoms	4	Dr. W. J. McCain	Sumter	May
½ to 2½	3	P. G. Lightfoot	Greene	May
....	3 or 4	E. F. Bouchelle	Greene	April 20,
1 to 5	3 or 4	J. O. Hays	Greene	May
2 to 4	4 to 6	S. Selden	Greene	Apri
1½ prairie 1 post oak 0 sandy land		J. McKee Gould, Jr.	Greene	May
....	4	W. M. Hill	Hale	May
....	4 or 5	B. B. Rudolph	Lowndes	May
3	3	M. H. Traylor	Lowndes	Fall sowing Ma Spring sowing .
1 to 3	4	J. A. Dillard	Montgomery	Mch
3	3	Judge W. H. Tayloe	Marengo	....
.....	4	Cobb & Macmillan	Sumter	Ap
2½	3	E. H. Allison	Morgan	....

The yields estimated by the above named alfalfa gr ers as the average production under their conditions dicate that after the first season alfalfa can be cut th to six times (usually 4 times), and that the yield of on good land is three or six tons per acre. Land ducing less than two tons per acre may yield profit, but should not be selected for alfalfa without f being fertilized with some legume, with manure, or w fertilizers.

The most usual date for the first cutting as found by above named growers is about the first of May or earl When sown in the spring one would expect no cutt of consequence for a month later, and much less t a normal yield the first season of growth. On poor la with unfavorable seasons no cuttings worth raking, obtained during the first season from spring sowing.

following extract from Bulletin No. 20 of the
ma Canebrake Experiment Station, at Uniontown,
red by the writer, illustrates the possibility of ob-
g from prairie soils large yields of alfalfa the first
, even from spring sowing.

tract of dark pebbly hillside of medium fertility
lowed and harrowed, and alfalfa seed was sown
cast on March 20, 1903. The stand was so thick
veeds were not troublesome until the growth of al-
was checked by drought, which prevailed almost
uously from about the middle of August until No-
r.

to that time alfalfa made rapid growth and af-
l three cuttings by September 3. Because of con-
is dry weather, growth after that date was too slow
other cutting to be obtained, though with the ordi-
rainfall of September and October a fourth cut-
vould doubtless have been secured.

is alfalfa occupied all of 'Cut 23' except 1-20th of
e, used for another forage plant. The area of this
according to a survey made by Mr. T. M. Cocoran,
5-100 of an acre. Mr. Corcoran's survey is made
sis of the calculated yield per acre in the follow-
ble.

ch cutting of hay required only one day in curing.
s then regarded by Mr. Richeson as dry enough to
in the barn, where it kept without molding.
e yields of hay thus cured were as follows:

	Lbs. per plot.	Lbs. per acre.
16	1,030	1,871
15	1,682	3,058
3	1,922	3,495
al	4,634	8,424

"This shows a yield of more than four tons of hay
acre when stored. It would probably not be safe t
gard this as thoroughly cured hay, suitable for st
in large masses. If, to be thoroughly conservative
assume that a further drying out to the extent of 2
cent. after being placed in the barn would be nece
before we could regard this as thoroughly cured hay
should still have a yield of more than three ton
acre. This is an unusually large yield for spring
alfalfa in its first season of growth, and is probab
much as can *ordinarily* be expected from very youn
falfa, even when sown in the fall. The conditions
ducing this large yield were a thick stand, abun
rains from March to August, thorough surface drai
and a supply of root tubercles.

"To emphasize the statement that this was up
prairie land of a fair degree of fertility, the follo
facts are mentioned: Corn without fertilizer and
out any special treatment, averaged in the two
which bordered the alfalf area 21 bushels per acre.
land sown to alfalfa in March, 1903, was in 1902 in
ton, without fertilizer; and in 1901 it had borne a
of corn without cowpeas. No stable manure had
applied in very recent years, and it is not known
any manure had ever been applied."

The following is another instance showing the p
bility of getting good yields from alfalfa the first se
even when sown in spring.

Mr. W. L. Ennis, Livingston, Ala., reports as foll
"Sowed 23 pounds of alfalfa seed, inoculated with
from a bur clover field, on March 20, 1903, on the
land we had, about one acre. Yields of baled hay
as follows:

"First cutting, 21 bales; second cutting, 40 b
third cutting, 17 bales. Total, 97 bales. Average w
of bales 104 1-2 pounds." This is about 5 tons per

PRICES AND PROFITS.

Those Alabama alfalfa growers who have sold alfalfa report that the price in recent years has been not less than $13 to $15 per ton. Even if we assume a minimum yield of 4 tons of hay per acre on land to which alfalfa is adapted, and a minimum price of $10 per ton, there would still be larger profits in growing alfalfa than most other field crops. Captain John C. Webb, of Demopolis, Ala., writes: "It has paid me better than any other crop I ever planted."

Mr. W. L. Foster is reported in Louisiana Bulletin No. 72 as follows in regard to alfalfa in the bottoms of the Red River, near Shreveport: "It costs an average of $1.25 to $2.00 per ton to put [alfalfa hay] in shape for the market."

The books of another alfalfa grower in the same region showed a cost of $1.90 per ton to cut, cure, market, and bale a crop of this hay.

The same publication contains this significant paragraph as to the profits of alfalfa in that region:

"When the land is seeded to alfalfa by the owner and rented out, he gets fifteen dollars an acre, and the renter furnishes his own harvesting tools, or he gets eighteen dollars rent and furnishes the harvesting tools. This is on land that rents for five dollars an acre for cotton."

SOILS FOR ALFALFA.

At present the most important question in connection with alfalfa in Alabama is the determination of soils on which it can be made a profitable crop. In determining the best soils for alfalfa we shall be helped by bearing in mind that this plant needs a soil (1) well supplied with moisture, (2) well drained, (3) having an abundance of lime, (4) rich in other plant food.

Alfalfa is at its best when grown under irriga
which fact indicates its response to large amount
water judiciously applied. In humid regions alfal
pre-eminently a crop for valleys, because on these
levels there is a relative abundance of moisture even
ing dry seasons. On the other hand, the roots of al
in congenial, well drained, permeable soils, penetra
great depths in search of moisture. But with the
drainage in a large part of the south this habit of al
is not fully utilized. The need for ample supplie
moisture can be better understood by the statement
ordinarily hay plants must pass through their le
about 400 tons of water for every ton of hay produ
or 1,600 tons of water per acre for every crop of four

Drainage, important for most ordinary farm crop
cause of the need of the roots for air, and becau
the deeper growth of roots in drained soil, is doubly
portant for any leguminous or soil-improving plant
alfalfa. For not only do the roots of such plants
water, but the nitrogen-fixing bacteria in the root tu
cles must have thorough soil ventilation in order to
form their work of transforming the valueless nitr
of the air into the valuable nitrogen of plant food. W
ever may be thought by some of the sufficiency of sha
ditches and levees for draining prairie land suffici
for cotton and corn, it is certain that such mere su
drainage is insufficient for alfalfa, as, indeed, we be
it to be for the maximum results with other crops. I
er ditches are needed for alfalfa.

No argument is needed to show the greater conven
and saving of land and work if some of these di
could be converted into underground drains, whether
drains of plank, pole drains, or whether tile be the m
ial employed. If tile drainage in Alabama
be shown to be cheap enough and continu

ctive for any field crop, that crop will be alfalfa. ile few farmers owning land valued only at or $25 per acre will be found at present willing to ke the large expenditure necessary for tile drainage, investment will doubtless be found feasible on cer- stiff bottom lands, otherwise peculiarly adapted to lfa, especially as these lands advance in price because heir suitability to alfalfa. The establishment of tile tories in the south, or the co-operative purchase of tile chines would so greatly cheapen the cost of tile drain- as to make it practicable for alfalfa fields and other d farmed intensively.

lfalfa should endure for many years. One of our respondents has alfalfa plants seventeen years old wing on prairie land. If a field of alfalfa, free from ease and from excessive growth of weeds, begins to when only a few years old, deficient drainage may be pected. Alfalfa is usually spoken of as needing an n soil. While permeability is desirable, yet in Ala- na the soils to which it has thus far proved best adapt- are lime soils of close texture.

PRAIRIE SOILS.

'aking up the different soils somewhat in the order of ir proved or probable fitness for alfalfa we must deal t with the Central Prairie Region of Alabama, extend- from Union Springs in a northwest direction past ntgomery, Selma, Uniontown, Demopolis, and Living- n, and into Mississippi. In this region a few very all patches of alfalfa were grown many years ago. So as I can learn, Capt. J. C. Webb, of Demopolis, was first one in that part of the State to grow alfalfa on considerable scale. One of his earliest plantings was de on a shallow gray soil underlaid near the surface h white rotten limestone. This field lay next to the

Tombigbee bluffs, on the western edge of Demopolis, a
hence was well drained. Steers had been fed here on c
tonseed meal and hulls, and the growth of alfalfa w
most satisfactory. Capt. Webb has since largely incre
ed the area which he devotes to alfalfa. The prinic
part of the alfalfa area of Alabama is now in Greene a
Sumter counties.

Prairie soils may be subdivided into quite a number
classes merging into each other by imperceptible gra
tions. Those prairie soils are best suited to this cr
which are best drained and best supplied with vegeta
matter.

Extensive inquiries were made of a number of grow
of alfalfa in Alabama, and below follows a summary
their answers to the question as to the character of s
in the prairie region best suited to alfalfa.

All expressing an opinion preferred lime to sandy
clay soils. Black prairie is the choice of most of th
correspondents, some of these expressly naming bla
bottoms or slough land, others fertile black upland s
Those who prefer bottom land specify bottoms that
well drained. Two prefer "hammock" land, one of th
describing his favorite alfalfa soil as "alluvial la
overlaying stiff prairie." One choses shelly prairie, t
cedar "hammock," and one gray upland prairie a
"hammock," and another yellow prairie. One cor
spondent has succeeded best in growing alfalfa on
mixed soil at the base of white marl hills.

On the farm of the Canebrake Experiment Station
Uniontown, alfalfa has done remarkably well during
first year's growth on upland of medium quality, a
containing a small number of rough pebbles. We are
from recommending alfalfa for that grade of prai
soil that consists *largely* of these roughened pebbles a
that is too poor to make fair crops of cotton. Alfa
needs fertile soil.

Answering the question what soils are unfit for al-lfa, these correspondents are almost unanimous in ming sandy soils. Three (including one farmer who is a very large acreage in alfalfa) specify post oak, id one especially designates black post oak.

With the confessedly incomplete data now available e soils of the prairie region of Alabama may be tenta-vely ranked in about the following order as regards eir suitability for alfalfa:

First class: Black bottoms, well drained, and drain- alluvial lime bottoms containing a little sand.

Second class: Black uplands; shelly gray uplands, id rich chocolate uplands.

Third class: Poor gray to white prairie, and poor, iff red or post oak land.

OTHER LIME SOILS.

As to the suitability to alfalfa of the soils of the re-ainder of the State, there is much less evidence avail-ble. From theoretical considerations there is every ason for expecting alfalfa to succeed in all the lime ils of the Tennessee Valley region, and in the narrow ne valleys in the northeastern part of the State.

Messrs. E. H. Allison and R. P. McEntire, of Decatur, rite of their success with alfalfa in that part of the ennessee Valley, and other instances of success in that rt of the State have been heard of, but not confirmed answers to our inquiries.

There is reason to expect the best red calcareous soils Talladega, Calhoun, and counties north of these, give satisfactory results with alfalfa. In a word, ere is a prospect for the successful growth of alfalfa rich, well drained lime soils in any part of the State here they occur.

Rich bottoms in every part of the State, if not subject

to long or otherwise injurious overflows, and no
wet or too sandy, are probably suitable for alfalf
they are deficient in lime it can be added with the p
bility of profit.

SANDY SOILS.

While it is possible that alfalfa can be grown
garden conditions, on almost any soils in Alabam
it is probable that it will not be a profitable sale cr
upland sandy or clay soils deficient in lime unless
are exceptionally rich. In order for it to be grow
all successfully, on these soils, great care will
quired and in many cases heavy applications of
manure or lime (the latter being supplemented by
amounts of commercial fertilizers) will be necessa
then becomes a question whether it is more profitab
these sandy uplands thus to coddle alfalfa or to re
hardier forage plants, as hairy vetch, cowpeas, soy
sorghum, etc. We are certainly not yet in a positi
recommend alfalfa for non-calcareous upland soils e
on a very small scale. However, the great value
plant on congenial soil makes it worthy of trial
small way on every class of soils.

LOCAL EXPERIMENTS IN PROGRESS.

To determine the suitability to alfalfa of each
principal soils of the State, this station in co-ope
with the United States Department of Agricultur
fall arranged for an experiment with alfalfa in
every county in Alabama. The unusually dry fall,
sitating late planting, and the early occurrence o
and freezes, destroyed the stand of alfalfa in many
experiments referred to. It is planned to contin
work along this line.

FERTILIZERS FOR ALFALFA.

One ton of alfalfa hay contains approximately 44 lbs. of nitrogen, 10.2 lbs. of phosphoric acid, and 33.6 lbs. of potash. Hence a crop of four tons contains as much nitrogen as is found in 2,450 lbs. of cotton seed meal, as much phosphoric acid as is contained in 336 lbs. of high grade acid phosphate, and as much potash as is contained in 1,075 lbs. of kainit. It would cost, to buy all these amounts of plant food in the form of commercial fertilizers, approximately $35.00. Fortunately not all of this is removed from the soil, the greater part being the value of the nitrogen, the largest proportion of which the alfalfa doubtless gets from the air. It would, however, require about $8.75 worth of phosphate and kainit to replace the amount of phosphoric acid and potash which would be removed from the soil of an acre by a crop of four tons. Hence it is evident that even the richest prairie soils, if cropped for many years in alfalfa, will need to have their supplies of phosphoric acid and potash replenished by the application of manure or fertilizers. This will be especially true if Johnson grass hay has previously been removed from these soils for a number of years, thus making heavy drafts on the soil's supply of these two minerals.

According to Wolff, one ton of alfalfa hay contains 70 pounds of lime, or 280 pounds in a crop of four tons. In three experiments on the station farm at Auburn lime has proved highly beneficial to the growth, permanency and hardiness of alfalfa.

In the case of soils not rich in lime it will be necessary from the beginning to apply this material, as is clearly shown in the experiments on the station farm at Auburn. Not only do lime and phosphoric acid directly stimulate the growth of alfalfa on soils deficient in these min-

erals, but their presence is believed to favor the dev ment of tubercles, on the abundance of which largel pends the thrift of the alfalfa plant. From 6 to 12 rels, equal to ½ to 1 ton of unslaked lime, or to at le to 1½ tons after slaking, may be applied per acre. Li (or the use of manure or wood ashes) will be indi sable for alfalfa on acid soils, of which there are areas in Alabama. To test a soil for acidity, a str blue litmus paper should be kept in contact with moist soil until damp. If the soil is acid the color o paper will change to pink. On application to the w litmus paper for this test will be furnished free.

Where there is no local experience to guide one i lecting fertilizer, the following formula (or stable nure), is suggested as a fertilizer for alfalfa, in re where the use of commercial fertilizers is general:

400 pounds acd phosphate per acre and 50 po muriate of potash per acre.

The above is not intended to take the place of where the soil is deficient in lime, but tos upplemen When lime and acid phosphate are both used for any they should be applied separately, and one shoul worked into the soil before the other is applied. T cles on the roots of alfalfa should supply it with n gen. But if the roots are devoid of tubercles, nitra soda or cotton seed may be needed.

FERTILIZER EXPERIMENTS AT AUBURN.

On reddish sandy upland soil at Auburn, capab producing only about 10 to 12 bushels of corn per without fertilizer, ten plots of alfalfa were sown, ber 29, 1900. The soil was not acid. All plots we that time fertilized at the same rate per acre, nar 320 pounds of acid phosphate and 80 pounds of sul

potash. An effort was made to inoculate the seed, t this was not entirely successful.

A good stand of plants was found on all plots the lat- part of the following March and the early part of oril, when different nitrogenous fertilizers were ap- ed to these plots as shown in the next table.

Alfalfa made extremely poor growth in 1901 on the ots receiving no manure. On all plots, weeds, leaf rust, sclerotial disease of the roots, and perhaps nitrogen rvation, killed the larger part of the plants. The lime d the stable manure plots suffered least and kept the st stands. No plot made a yield worth harvesting separ- ely. October 7, 1901, without plowing, an additional ount of seed was disced in on all plots.

Again in the phenomenally dry summer of 1902, the alfa on *most* plots did not yield enough hay to justify king it up. However, the plots were clipped four nes in 1902—May 6, June 17, Sept. 13, and October On the best plots, those to which stable manure had en applied about 15 months before, and which were w reduced by disease and dry weather to a mere frac- n of a stand, the yield was only about one ton of hay the entire season. The extreme drought of 1902, ending practically from the middle of April to Aug- , will be recalled by most readers.

In the summer of 1902, the poorest plots of alfalfa re plowed up and planted in New Era cow peas in lls. These made slight growth, but were kept clean late cultivation. The plots then plowed up as being poorest were those which 18 months before had re- ved per acre either 200 pounds of nitrate of soda or) pounds of cotton seed meal or no fertilizer.

September 13, 1902, inoculated alfalfa seed, 20 lbs. the acre, were sown on these plots, first running a

disc harrow several times over the small growth c
pea vines, a procedure that in ordinary seasons
not suffice to dispose of a crop of cow peas of the
luxuriance, but which is sometimes a satisfactory
ment of cow pea stubble. On all these plots and nea
other plots, 2,000 lbs. of slaked lime (equal to about
lbs. of unslaked lime) were harrowed in. Next
certain other plots where the stand had become ver
were plowed and sown in alfalfa.

The stand of alfalfa on other plots, (those
eighteen months before had been fertilized with
manure or lime), was thickened by drilling in v
grain drill a small amount of alfalfa seed, mixed
sand to make the distribution more uniform.

The yields of hay obtained in 1903 on each pl
shown in the following table:

Pl				May	July	Sep	Tot
1	Sept. 13, 1902........	320 lbs. acid phosphate 80 lbs. sulphate potash.	240 lbs. acid phos. 1 ton slaked lime.	....	700	900	1600
2	Sept. 13, 1902........ Drilled.	200 lbs. nitrate of soda. 80 lbs. sulphate potash. 320 lbs. acid phosphate.	240 lbs. acid phos. 1 ton slaked lime.	....	500	1000	1500
3	Sept. 13, 1902........	500 lbs. cotton seed meal. 320 lbs. acid phosphate. 80 lbs. sulphate potash.	1 ton slaked lime.	....	1100	1200	2300
4	March 18, 1903......	320 lbs. acid phosphate 80 lbs. sulphate potash.	6 tons horse manure. 1 ton slaked lime.	....	1600	2000	3600
5	Oct. 29, 1900........	20 bbls. lime. 320 lbs. acid phosphate. 80 lbs. sulphate potash.	240 lbs. acid phos. 1 ton slaked lime.	2300	2050	2300	6700
6	Oct. 29, 1900........	18.4 tons horse manure. 320 lbs. acid phosphate. 80 lbs. sulphate potash.	240 lbs. acid phos. 1 ton slaked lime.	2400	2200	2200	6800
7	March 18, 1903......	80 lbs. sulphate potash. 320 lbs. acid phosphate. 22.2 tons cow manure.	240 lbs. acid phos. 1 ton slaked lime.	....	900	1600	2500
8	Oct. 29, 1900........	22.5 tons horse manure. 320 lbs. acid phosphate. 80 lbs. sulphate potash. 20 bbls. lime.	240 lbs. acid phos. 1 ton slaked lime.	1400	1100	2000	4500
9	March 18, 1903......	320 lbs. acid phosphate 80 lbs. sulphate potash.	80 lbs. nitrate of soda. 240 lbs. acid phos. 1 ton slaked lime.	....	800	1000	1800
10	March 18, 1903......	6 tons rotton cowpea vines 320 lbs. acid phosphate. 80 lbs. sulphate potash.	340 lbs. acid phos. 1 ton slaked lime.	....	900	1300	2200

The results for 1903 shown in the above table ma
summarized as follows:

(1)—Spring and fall sowing afforded practicall
same yields, about one ton of hay per acre the first
mer.

(2)—Nitrate of soda applied at the rate of 80 po
per acre with the seed in spring failed to increas
yield.

(3)—Six tons of stable manure more than dou
the yield the first season when applied in Februa
fall sown young alfalfa plants.

(4)—Eighteen tons of stable manure enabled al
to yield 3.4 tons of hay per acre the third season
the application.

(5)—Lime, at the rate of 20 barrels per acre, re
ed the third year after application in a crop practi
equal to that obtained by the use of 18 tons of s
manure at the same time.

(6)—The application of both lime and large amo
of stable manure together did not increase the yiel
third year after application as compared with eithe
plied alone.

The first cutting of hay was nearly pure alfalfa
second contained considerable crabgrass, and the
cutting contained more crabgrass than alfalfa.

EFFECTS OF LIME AND INOCULATION COMBINED.

On October 3, 1902, three plots of sandy soil of
quality on the Experiment Station farm at Auburn
sown with alfalfa. Phosphate and muriate of p
were used on all plots. Polt 3 had neither lime no
oculation; plot 4 was not limed, but inoculated a
lows: Soil from an old alfalfa field 100 yards dis

was stirred into water, the seed dipped into this water, and then thirty bushels per acre of the same soil was sown broadcast and harrowed in promptly. Plot 5 was similarly inoculated and 1,000 pounds per acre of slaked lime was applied. Winter killing was severe on all plots, but much more severe on plots 3 and 4 than on the plot which was both limed and inoculated. Figure 1 shows in the lower part that on the plot both limed and inoculated the young plants had covered the ground; few and small were the plants surviving plants on plot 4, as shown in

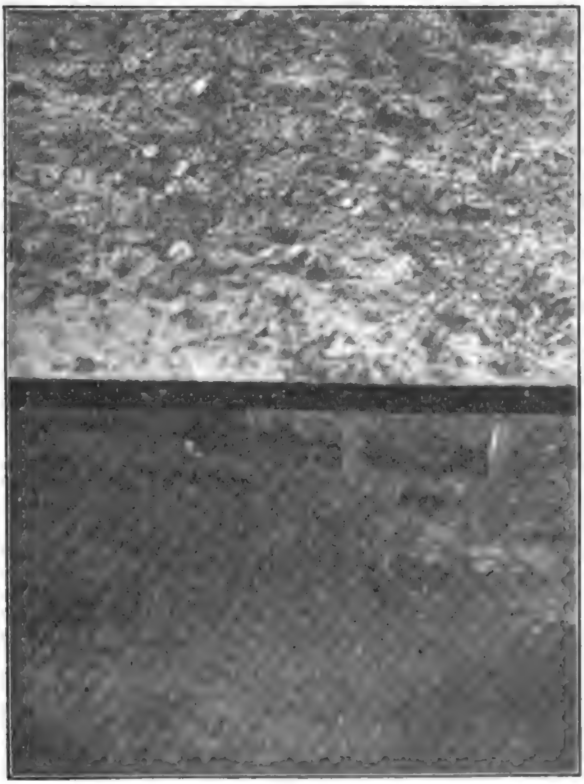

Fig. 1. Below. ground is covered with young plants, which have been inoculated and limed; above, lime omitted, and ground nearly bare.

the upper part of Figure 1. Figure 2 shows ty plants taken in April from each plot. Note the a ance of tubercles on the plants from the plot tha both limed and inoculated. The liming and inocul seemed to make the young plants hardier and mo sistant to cold. No one of these plots was a success, being left at the end of winter only about half a sta plot 5, and much less on the other two plots. The yield for the season was 2,266 pounds per acre wher ing and inoculation had been employed, while o other plots there was not enough hay to be raked.

Fig. 2. Small plants not inocuated; central plant, not limed; est plant, inoculated and limed.

An adjacent plot was sown in crimson clover at the same time that the alfalfa was sown, and after the cutting of the crimson clover, the same plot was sown in June in broadcast sorghum. The yields obtained give an interesting illustration of the fact that under ordinary conditions on sandy land unsuited to alfalfa, other crops often furnish a far larger quantity of forage. The yield of crimson clover on this adjacent plot was 6,100 pounds per acre, and the amount of sorghum hay obtained at one cutting during the same season was 13,000 pounds per acre. These are exceptionally good yields of both crimson clover and sorghum. This is an extreme case where all conditions were highly favorable for crimson clover and sorghum, and exceedingly unfavorable for alfalfa.

FERTILIZER EXPERIMENTS ON PRAIRIE LAND.

A series of fertilizer experiments on 10 plots was begun in 1902 in co-operation with Mr. J. O. Hays, Sumter county, Ala., by whom the fertilizers were applied in accordance with the writer's plan. The seed were not sown until April 3, only a few weeks before the beginning of the memorable drought. In the absence of any considerable amount of rain until August 28, the fertilizers were without effect. No hay was raked, but Mr. Hays reports that this alfalfa, though sown late, "stood the drought better than any other forage plant, and is the only one that kept a good lively green color, while Bermuda grass was parched perfectly yellow, and sorghum was twisted and stopped growing."

It should be added that eight of the plots were inoculated with soil from an old alfalfa field.

In 1903 Mr. Hays again undertook a fertilizer experiment for this station. On June 13 he writes: "Plots 9 and 10, the ones most highly fertilized, are the best."

These both received per acre 200 pounds cotton
meal, 240 pounds acid phosphate, and respectivel
and 100 pounds of kainit.

MANURE.

For the prairie region it may be said that no fer
except stable manure has yet been sufficiently test
alfalfa to determine its suitability. In numbers
stances stable manure has greatly increased the yi
alfalfa on prairie lands, and the most experienced
ers of alfalfa use it so far as the limited supply pe
The benefit from the use of stable manure is a co
experience in west Alabama, and the application o
nure has immensely increased the yield of alfalfa o
lime land of Mr. J. A. Dillard near Montgomery, A
the writer can testify from a personal inspection.

However, the question may well be raised whethe
falfa is the best crop on which to apply stable ma
which is so scarce and so sure to largely increas
yield of any crop. So far as concerns the nitrog
stable manure, alfalfa could well dispense with
For alfalfa thoroughly inoculated and on land suffi
ly well drained to insure fair soil ventilation, s
be able to obtain through its root tubercles unli
quantities of nitrogen from the air. On the other
sorghum or cotton, not having this means of sec
nitrogen, would make good use of the nitrogen as
as of the other constituents of stable manure. In
of the application of manure to alfalfa is the fact
this application in winter promotes early develop
of the plants, and forces the alfalfa to a sufficient h
for cutting at a time when other forage is scarce. I
over, if immense quantities of stable manure are us
will serve as a mulch, retaining the moisture in th

and alleviating the effects of drought. On the other band, surface application of manure without incorporation with the soil results in great loss of the valuable portions of the manure and is ordinarily a wasteful method of application.

INOCULATION.

Alfalfa belongs to that family of plants able to derive a large part of their nitrogen from the gaseous nitrogen of the air. This is done through the agency of enlargements on the roots, called tubercles or nodules. Within these tubercles dwell countless numbers of microscopic vegetable organisms, usually referred to as nitrogen-fixing bacteria or germs.

Root tubercles of alfalfa, clovers, vetches, cowpeas, velvet beans, and other legumes, are essentially fertilizer factories engaged in the manufacture of nitrogen. This is a fertilizer material, which, when bought in the form of cotton seed meal or nitrate of soda or ammoniated guano, costs about 15 cents per pound. The importance of the work of root tubercles may be realized from the fact that a crop of any one of these plants growing on an acre usually contains from 75 to 200 pounds of nitrogen in roots and tops taken together.

When the germs necessary for causing tubercles to develop on the roots of alfalfa are absent from the soil and from the seed, the roots of alfalfa have no tubercles. The proper germs, which we may designate as alfalfa germs, are usually absent from the sandy and noncalcareous soils of Alabama, and often from other soils. More frequently there are a few of the proper germs present either in the seed sown or in the soil, so that tubercles develop on a small proportion of the plants.

A leguminous plant without tubercles is a drone

that no farmer can afford to provide for. Such pl depend entirely upon fertilizers for their exper nitrogen or draw it from the earth, thus impoveris the soil.

The farmer has it in his power to cause tubercle develop on the roots of his alfalfa, and thus to force plants to provide their own nitrogenous food, an enrich the land in nitrogen. When leguminous pl form their tubercles without aid from man we speak of the process as natural inoculation. Ex ments on a number of soils at Auburn and observat of young alfalfa plants in a number of other locali lead us to conclude that the alfalfa germ is wantin not present in sufficient numbers in most of the sa and clay soils of Alabama that are deficient in li On such soils the necessary germs must be supplie the process of inoculation, or more accurately, by ficial inoculation.

The material used for inoculating alfalfa may be from a field where alfalfa or bur clover (a plant of same genus) has in recent years been well sup with root tubercles, or it may be a concentrated pa ed material now being manufactured in the laborat of the United States Department of Agriculture.

To inoculate with soil we have used the follo methods, depending on convenience and on the am of inoculating soil available.

(1) With small amounts of inoculating soil: about a peck of soil from an old alfalfa or bur cl field add several gallons of water; stir well; allo few minutes for settling and then moisten every al seed thoroughly with the muddy water, which cont the necessary germs. Then dry the seed by mi with them more of the same inoculating earth in a condition and crushed as fine as possible. Cover promptly.

(2.) With large amounts of inoculating earth: Moisten the seed as above; dry as above, if convenient; sow broadcast per acre 20 to 30 bushels of the same earth in as fine a condition as possible, and harrow in seed and inoculating earth as promptly as possible. The method of inoculation and the amount of inoculating soil can be varied according to convenience.

Directions for use accompany the pure cultures sent from Washington. Dr. A. F. Woods, under whose direction this inoculating material is distributed, authorizes me to state that the Department will supply free inoculating material for alfalfa to any parties whose names I shall send in, and who will furnish their own seed. Applicants should state the number of acres that they will plant.

On prairie soil the writer has repeatedly observed that alfalfa plants are, when young, well stocked with tubercles. The cause for this is evident from the recent investigation of Dr. C. G. Hopkins, of the Illinois Experiment Station. Under date of February 2, 1904, he writes as follows with reference to his bulletin now in press, and gives permission for this use of his results: "The investigations reported in this bulletin prove conclusively that the bacteria of sweet clover are similar to the bacteria of alfalfa."

RESULTS OF INOCULATION OF ALFALFA ON SANDY LAND.

In an inoculation experiment with alfalfa made by the writer in February, 1897, the yield of alfalfa at the first cutting was increased 336 per cent as the result of inoculation. The soil within the plots was from a sandy field near Auburn, and the inoculating material was the dust sifted out of bur clover seed and derived from the soil on which bur clover had grown. In several later

field experiments the use of bur clover earth has duced tubercles and greatly increased the yield o falfa.

Figure 2 shows typical alfalfa plants taken in A 1903, from three plots at Auburn, sown the prece October. The small plants on the right had been ne limed nor inoculated and were free from tubercles; t in the center had been inoculated, but not limed; largest plant had been inoculated and limed, and the supply of tubercles is abundant. Soil from an alfalfa field was used in this experiment as inocula material.

INOCULATION OF ALFALFA ON PRAIRIE SOILS.

In the light of Dr. Hopkins' demonstration can now see why it is unnecessary to inocu alfalfa on fields where melilotus (sweet clo has recently grown, and produced tubercles, it almost invariably does on prairie soil. would still seem advisable, however, to inocu alfalfa seed to be sown on such prairie land as not recently grown melilotus. While these germs probably been widely distributed by wind and water otherwise, in the prairie region, we have no proof they are present in all fields of prairie land in suffi numbers for *best* immediate results with alfalfa.

Indeed the observation made by Mr. J. O. Hay our fertilizer experiment on gray prairie land in Gr county, previously referred to, seems to indicate there is an advantage, at least during the first months of growth, in inoculating alfalfa on some land. In 1902, on land which had been used as a ture for a number of years, he reports that on the months-old inoculated alfalfa plants tubercles

abundant, while up to that time none had been found on the plots not inoculated.

Relative to a similar experiment in 1903, he writes under date of June 13, 1903, as follows: "I inoculated all plots except No. 8, which seems to be the poorest of any of them.'"

In view of Dr. Hopkins' conclusions, we can now recommend that earth from an old melilotus field be used for inoculating alfalfa, where this is decidedly more convenient than to use earth from alfalfa or bur clover fields or than the pure culture of the laboratory.

TIME TO SOW.

The following is a summary of results of sowing alfalfa on the station farm during the eight years that work has been under the writer's charge:

We have records of fall sowings on ten different dates. In every case when alfalfa was sown broadcast after November 1, the stand was ruined by cold. In one case alfalfa sown as early as October 7, (1901), was almost completely winter killed. Plants from seed sown as early as September 13 (1900), and as late as October 29 (1899) survived the winter, although in other years a considerable proportion of the sowings made in late October resulted disastrously.

We have records of eight dates of spring sowing of alfalfa on the station farm. These point to the first half of March as better than a later date.

In our co-operative experiments with alfalfa in 1903-1904, arranged for in nearly every county in the State, fall sowing was made unduly late by drought, and cold weather came on unusually early, and has been unusually continuous. Moreover, in most cases there was insufficient moisture to cause the young plants to grow

rapidly. Under these conditions, it is estimated
reports thus far received that in considerably
than half the experiments the stand of alfalfa was
ed. These reports afford an interesting compari
the relative hardiness towards cold of the young
of alfalfa, crimson clover and hairy vetch. Th
two, when very young, are almost equally sensiti
cold, while hairy vetch is much hardier in this r
than either.

Alfalfa has been successfully sown in Alabama
in the early fall and in the early spring. The pri
advantages of fall sowing are the following:

(1.) A larger yield of hay obtainable the first
mer;

(2.) Less danger of having the alfalfa ove
and crowded out by crab grass and weeds;

(3.) Use of teams in preparation for alfalfa in
ust and September, when they would not be em
in preparing for the usual crops.

The chief advantages of spring sowing are as fo

(1.) Freedom from risk of winter killing, to
fall sown alfalfa, especially that sown late, is liab

(2.) Opportunity to sow alfalfa after cotto
best of the hoed crops to precede it;

(3.) Usual better condition of the land for pl
in December and January than in August and Se
ber.

Each reader must contract these opposing adva
in the light of his own conditions. By far the
proportion of alfalfa sown in Alabama on prairie
is put in after Christmas, which suggests that t

nerally the most convenient time. Some years it is e only practicable time, the ground being too dry and rd in the early fall. Several extensive growers of alfa who sow chiefly in the spring, nevertheless express preference for fall sowing when there is sufficient oisture for thorough preparation and for sowing *early* the fall.

Fall sowing should occur at a date early enough to rmit the roots to penetrate deeply before freezes be-n, and thus to anchor the plants against heaving. Not ly are young alfalfa plants easily heaved or lifted out the soil by alternate freezes and thaws, but the very ung plants are otherwise and more directly injured severe cold following mild weather.

In Central Alabama we would recommend that fall wing be done, if practicable, from September 15 to tober 15, with the preference for the earlier part of is period. While a date as late as November 1 oc-sionally gives success, the risk of winter killing is en too great. If alfalfa cannot be sown before Octo-r 15 in central Alabama, we would recommend that wing be postponed until March.

The safest period for spring sowing is from March 1 20. Some sow on prairie land as early as February , but from February sowing at least one instance loss of stand from cold has come under our notice. hile seed sown in April sometimes succeed, the suc-ss is less uniform than with March sowing. The more edy the land the stronger the reason for fall sowing.

PREPARATION.

There is no field crop that pays better for thorough eparation than alfalfa. The man who is content to epare land for alfalfa as he would for oats had best

leave this crop to some one else. The plowing
falfa should be deep and thorough and it is hig
bable that subsoiling on prairie and other st
would be more profitable for alfalfa than for a
field crop. Harrowing must be done, not once, b
two to four or more times, according to the c
of the land. Usually two harrowings with a d
row and two with a tooth harrow (including
given after sowing the seed) will suffice.

Harrowing for fall sowing will be most eff
done within a few hours after plowing. For
sowing this is less imperative. It is important
tween the time of plowing and the time of sowing
cient interval should elapse for rains to compac
tle the soil. If sufficient rain does not fall to s
soil, this should be done by repeated use of r
weighted drag. One of the most common causes
ure to secure a satisfactory stand in alfalfa
consists in having the soil too loose at plantin
For fall sowing plowing should occur at least
weeks before the seed are to be sown. If alfal
be sown about the first of March the plowing
done in November or December, or January, mo
factorily than just before planting. Land plo
fore Christmas will only need to have the surfa
freshened with the harrow at the time of
While the above statements embody the gen
perience, success sometimes attends the sowing
seed immediately after plowing. A farmer in th
eastern part of Texas who has many hundred
alfalfa, describes his method of preparation
prairie for alfalfa as follows: "I use a disc pl
four good mules, run a subsoil plow drawn
mules eighteen inches deep behind the disc.
follow with a disc harrow with four mules, th

the land with an implement eight or nine feet long and five feet wide, made by 2x6's spiked together; six mules draw this. I can reverse the float, turn it over and use it to level the land in rough places. I am not yet ready to seed this land prepared in this way. I must have a rain on it that will settle it and take the air cells out. Then, with a light toothed harrow I break the surface, sow the seed with a wheelbarrow seeder and cover with a light harrow followed by a heavy steel roller. Good black land seeded in this way will return $40 or $50 per acre every year, at very little cost for labor."

One grower in West Alabama subsoiled his land for alfalfa last fall, but it is too early for the effects of subsoiling to become apparent.. One grower in the same neighborhood harrowed his land seven times, an extreme case. Others report satisfaction from one or two harrowings, a number often insufficient. It should be borne in mind that preparation for alfalfa is expected to suffice for from three to twenty years, and should therefore be thorough.

SOWING BROADCAST VERSUS IN WIDE DRILLS.

It is maintained by some parties that in the Gulf States drilling alfalfa, with such distance between rows as to permit of cultivation, will be more satisfactory than broadcast planting. In three experiments at Auburn and in one at Uniontown, drilling was unsatisfactory. On the station farm at Auburn it was found difficult in planting by hand in drills to avoid covering the seed too deep, and it was found that the amount of cultivation required to keep the grass and weeds subdued in drilled alfalfa was greater than it is practicable to give to a hay field.

On the Canebrake experiment farm at Uniontown,

where the drills were about 24 inches apart and n
tivation given, crab grass and weeds crowded t
falfa more than in the portion of the field sown
cast.

However, for a small patch of alfalfa kept fo
ing green, drilling and cultivation may be nec
and feasible, especially on highly fertilized sand
filled with the seeds of crab grass and weeds. Pl
in very narrow drills by the use of grain drill
favorite method in alfalfa-growing states. Th
course does not permit of cultivation.

SOWING.

Most of the successful growers of alfalfa in Al
have used about 20 pounds of seed per acre, and
the amount that has invariably been used on the
farm at Auburn. Capt. John C. Webb uses 40 p
The excellent stand obtained in 1903 at the Can
station resulted from sowing a little more th
pounds per acre. One grower in Alabama repor
use of 30 pounds, or half a bushel of seed. Ye
grower is one who most emphasizes the presence of
amounts of crab grass and fox tail grass, indi
that sowing large amounts of seed is not always
ive in crowding out weeds, though it has that tend

If ten or more acres are to be sown, it is best
one of the ordinary patterns of seed sowers inst
sowing by hand. The Cahoon is the one used a
station, and this seems to be in most general use
State. One grower makes use of the seed attachm
the disc grain drill, a method which is commo
satisfactory in states where this machine is in g
use. When alfalfa seed are sown by hand, the
even distribution is obtained by dividing the see
two parts and going over the land twice.

In Alabama alfalfa should be sown alone and not vith grain, which is so much used as a nurse crop for ılfalfa, clover and grasses in the North and West.

In covering alfalfa the procedure must necessarily liffer according to local conditions, the preparation of he land, and the state of the weather. The most comnon custom in Alabama is to cover with a spike tooth iarrow, teeth inclined backward. An equally good or etter way employed by a few growers is to cover the eed with a weeder, which affords a more shallow coverng than any form of harrow. A carefully made brush lrag can also be used, but either of the preceding implenents is preferable. We have found it advantageous vhen the land is dry to use the roller immediately after owing and then to use the harrow or weeder. This rder could be reversed, but at the risk of having the olled surface transformed into a dense crust, should a ieavy rain fall occur before the seed germinate. Coıurn, an authority on alfalfa, advises that when from ıny cause a crust has been formed prior to the appearınce of young plants, that this crust should be broken vith weeder or harrow, even at the risk of bringing ome of the sprouting seed to the surface.

It pays to buy the best alfalfa seed, even though they hould cost several cents more than inferior seed. Imorted as well as old should be avoided. So far as this nformation can be obtained, it is desirable to purchase eed grown in regions where love vine (dodder) is not ıbundant. In any case it is advisable to buy seed that ıave been run through a machine that is claimed to be ıble to remove the seed of dodder. As indicating the ıeed of buying the best alfalfa seed, even at an increasd price, one of the farmers who is conducting one of ıur alfalfa experiments in Wilcox county, under the

writer's direction, reports as follows, under da
January 23, 1904: "All the seed sent from Washi
came up readily to a good stand. * * * The se
bought did not make a 15 per cent. stand."

To test the germinating power of alfalfa, dampe
small pieces of cloth; place 100 seed between th
pieces of cloth. Then put the whole thing in a pl
saucer, cover it, and leave it in a warm room, repe
moistening the cloth before it dries. Count the see
sprout within ten days.

BEST CROPS TO PRECEDE ALFALFA.

A crop selected to get land in best condition f
falfa should be one that either leaves the land
and unusually free from weeds and weed seed, c
that adds vegetable matter, and hence enriche
soil. Cotton fulfills the first requirement, and cow
or melilotus the second. The land that is to be so
alfalfa next fall should be sown thickly in a ru
variety of cow peas in May, 1 1-2 to 2 bushels per
The vines should be cured for hay about a mon
more before the time for planting alfalfa. On soil
deficient in vegetable matter it may be profitab
plow under the entire growth of cow peas. If the
plan is followed, this mass of material should be p
under in ample time for rotting to occur, or from
60 days before the date of planting. When green
tation is plowed under at this season it is desira
compact the soil with the roller or heavy drag,
wise this vegetable matter before rotting will inju
ly dry out the soil by preventing the rise of cap
moisture from the moist subsoil. On soils defici
lime the lime necessary for alfalfa can be applied

ne green growth of cow peas is turned under, thus has-ening rotting and obviating the souring effect that might therwise occur. Melilotus furnishes vegetable mat-er and nitrogen for alfalfa, and also by means of the ecay of its large and deeply penetrating roots assists n the drainage of prairie soils. It is advisable to let ne carefully worked cotton crop, intervene between the urning under of the second years' growth of melilotus nd the sowing of alfalfa seed. This interval permits ne owner to free the land from any volunteer plants f melilotus and from weeds.

JOHNSON GRASS LAND FOR ALFALFA.

One of the important advantages of alfalfa is its bility to grow in land too thickly set with Johnson rass for the profitable cultivation of corn or even of otton: By the introduction of alfalfa or hairy vetch nto a Johnson grass meadow, the soil will be to some xtent enriched in nitrogen, the nutritive quality of the ay improved, and the total yield of hay increased.

An effort was made by correspondence with leading rowers, to learn whether the successful growth of al-alfa in Johnson grass meadows was conditional upon uch preparation of the land as would kill a large part f the Johnson grass. The general experience is that lfalfa thrives in old Johnson grass meadows even hen the preparation for alfalfa is such as would ordi-arily improve the growth of Johnson grass. The ver-ict was almost unanimous that Johnson grass did not rowd out the alfalfa in the second or third year after ne alfalfa was sown. Those with the longest experi-nce were as emphatic as others in stating that alfalfa as quite equal to a contest with Johnson grass, and ome growers even stated that the alfalfa was tending

to crowd out the Johnson grass. When alfalfa
in land stocked with Johnson grass, fall sowi
the alfalfa an advantage over its competitor.
further means of giving the ascendency to alfa
sists in breaking the Johnson grass land and
thickly with cow peas, cutting the cow peas an
son grass for hay, and turning under the st
month or more before sowing alfalfa seed.

PRINCIPAL ENEMIES OF ALFALFA.

Among these first rank must be given we
weedy grasses, chief among which is crab gras
grass and absence of tubercles have been respon
the majority of failures that have come under the
observation. Other weeds that have given troub
falfa on the station farm are evening primrose,
glories, pepper grass, and even lespedeza or Japa
Among weeds most troublesome in prairie regi
crab grass, Bermuda grass, *Sida spinosa*, (a rat
branched weed with small yellow flowers an
leaves), morning glories, fox tail grass, prairie
grass, horse nettle, and cow itch vines.

The only method known for decreasing inju
weeds is one of prevention rather than cure.
jury from weeds is best prevented by growing
fore alfalfa, cotton or some other crop requiri
ful cultivation. The avoidance of manure ma
feeding hay abounding in weed seeds is also ad
Manure from cattle fed on cotton seed meal a
is the best kind for alfalfa. Fall sowing is on
best means of enabling alfalfa to get a start
umph over its many enemies among the weeds
cious use of the disc harrow and even the use
weeder when crab grass has just appeared is so
helpful.

Dodder, which is often introduced in alfalfa seed, is a thread-like, yellow vine, feeding on and destroying alfalfa. Mowing and burning in place is the most convenient of several remedies.

The most successful method of combatting weeds consists in frequent mowing during the first year, even when the alfalfa plants have not attained sufficient height for hay making. Repeated clipping with the mower during the first summer will do much to repress weeds and to thicken the stand of alfalfa by making the plants throw out a greater number of stems.

Leaf rust on alfalfa, appearing in the form of small black spots on the leaves, has been very destructive to alfalfa on the station farm, especially during damp weather. When it becomes serious, the best thing to do is to mow the alfalfa, the new growth usually escaping injury for quite a while.

A more fatal disease occurring on alfalfa on the station farm is a sclerotial root disease, which, however, the writer has not observed in other alfalfa fields. Indeed this root disease has been the principal cause of failure of our most promising fields of alfalfa, a large proportion of the plants in certain fields being killed by it.

CLIPPING AND DISCING ALFALFA.

After the young plants appear the most effective aid that can be given them is to use the mower frequently. Clip young alfalfa whenever weeds crowd it, and whenever it rusts or turns yellow from any cause. If the growth is slight, leave the mown material on the ground as a mulch and fertilizer, provided it is of a kind that will not give trouble when hay is raked after a later cutting.

Old alfalfa, whose growth has been arrested ,and w
has become unthrifty, is often benefited by prompt m
ing, even though the growth be too light for harves

The next most important treatment usually re
mended for alfalfa more than a year old is to run a
harrow over it when needed. This is sometimes
after each cutting, but judgment is needed in this ma
The discs are set straight so as not to cut off the pl
Discing serves as a cultivation and to thicken the sta
old alfalfa. On sandy land at Auburn we have found
weeder useful in young alfalfa in killing very yo
grass and weeds just germinated.

At Auburn crimson clover sown early in Octob
old drilled alfalfa was ready for cutting at the same
as the alfalfa, and the combined yield was large.
combination is not advised except when the stand o
falfa has become so thin that it is about time for it t
plowed under.

TOLERANCE OF ALFALFA TOWARD OVERFLOWS.

When excessive rains occur and poorly drained
remains saturated for a long time, alfalfa somet
take on a pale yellowish, sickly color. This plan
classed as among those least able to endure prolo
saturation of the soil. Yet the large yields obtaine
bottom lands make it worth while to take some cha
of injury from overflows, especially on soils so dra
naturally or artificially that the ground soon dries
the waters subside.

An overflow does not necessarily mean the destruc
of the alfalfa plants. Experience in other states
cates that alfalfa may pass safely through a subm

ence of several days if all conditions are favorable. Its endurance of overflow is greater when the water is moving than when it is stagnant, and greater during the cooler periods of the year than when the plant is in a more active stage of growth. The deposit of much sediment on the plant, and hot, fair weather immediately after the water passes off are conditions unfavorable to recovery. Rains, washing off the sediment, are favorable to recovery.

In a bulletin of the Texas Experiment Station are cited two instances in which alfalfa in the Brazos River bottoms was under water for five or six days in summer without the destruction of the stand, except where the deposit of sediment was great or on poorly drained areas. These are extreme cases, and refer to soil that was well drained. Mr. R. P. McEntire, of Decatur, Ala., gives his experience with overflow as follows: "In the fall of 1901 I sowed 3 acres October 15, and got a good stand. In January we had an overflow from the Tennessee River, which was out over the land for two weeks. In a few days we had a hard freeze. Then on February 15 we had another overflow, which lasted 10 days. As the water went off we had another freeze. When spring opened I had something like half a stand." It would seem that one might raise alfalfa on land naturally well drained and where the overflows occur chiefly in winter, and where it is unusual for the water to remain on the land as long as three or four days in winter or two days in the warmer part of the year.

HARVESTING ALFALFA.

A discussion of the methods of harvesting alfalf
of the machinery and devices employed would undu
tend this bulletin. In brief, alfalfa should be cure
the shortest practicable exposure in the swarth
sun. The leaves are the richest portion of alfalfa,
the hay is sunned too long the leaves drop off. Th
ferred time for cutting alfalfa is when about one-
in bloom, but this varies with the weather and wi
thrift of the plants.

SUMMARY.

Alfalfa is a perennial leguminous plant, usef
hay, feeding green, pasturage, and for soil im
ment. In nutritive qualities alfalfa stands in the
rank, and when fed to farm teams the ration o
can be greatly diminished. On suitable soil the yi
hay exceeds that of any other hay plant. On
soils in Alabama yields of more than 3 tons pe
were in two instances obtained within seven n
after sowing the seed, and the yield continues to in
for several years. Farmers report 3 to 5 tons pe
as the usual yield of hay per acre on prairie soil i
bama, and in a number of instances these yield
greatly exceeded.

Alfalfa makes an unrivaled hog pasture, and i
recommended as a pasture plant for horses and n
Cattle and sheep sometimes bloat when grazing

alfa. Pasturing, especially during the first year, in-
ures and sometimes kills alfalfa.

Soils for alfalfa should be rich, well drained, well upplied with lime and vegetable matter. Alfalfa has een repeatedly demonstrated to be a success on the est grades of prairie soil on both uplands and lowlands. There is reason to believe that alfalfa will thrive on the ime soils of the Tennessee Valley region and on other alcareous soil in Alabama, and on fertile, well drained, lluvial soils in nearly every part of the State.

A crop of 4 tons of alfalfa hay contains 176 pounds of itrogen, 40.8 pounds of phosphoric acid (equal to that n 336 pounds of high grade acid phosphate), 134.4 ounds of potash (equal to that in 1,075 pounds of kain-t, or in 269 pounds of muriate of potash, and 280 pounds f lime. To replace only the phosphoric acid and potash y commercial fertilizers an expenditure of about $8.75 vould be required.

The preparation of the land for alfalfa should be thor-ugh, including plowing as deep as practicable, and re-eated use of disc and spike tooth harrow. Generally it s best to plow a number of weeks before the seed are to e sown. A weeder or light harrow is the preferred mode f covering the seed, which are sown broadcast at the rate f 20 pounds or more per acre. Fall planting before Oc-ober 15, when practicable, gives alfalfa a start ahead of veeds, but spring planting (early in March), is usually nore convenient.

Alfalfa, especially that sown in the spring, requires and as free as possible from seeds of weeds, crab grass, tc. Repeated use of the mower during the first year is he preferred method of combatting weeds in alfalfa.

Planting alfalfa in drills and cultivating it may be

suitable for a small patch kept for feed ng green, b
system was found impracticable for a hay field.

Usually the best crop to precede spring sown
is cotton, especially if cotton follows melilotus
clover). The best crop to prepare the land for fal
alfalfa is cow peas, sown very thick.

Numbers of farmers have found that alfalfa
when sown on Johnson grass meadows, holding it
at least for the first few years, against this agg
grass.

Dodder, a yellow thread-like growth, is a
enemy of alfalfa. One of the remedies consists in
ing and burning. Seed merchants often pass
seed through a machine which is claimed to remo
dodder seed.

On sandy upland soils at Auburn alfalfa has
forded very profitable yields. On such soils it re
heavy applications of lime or barnyard manure,
is believed that more profitable use can be made
nure. At Auburn neither nitrate of soda nor cotto
meal very greatly increase the yield of alfalfa th
properly stocked with root tubercles. Acid pho
and potash fertilizers are considered indispensibl
and generally advisable on sandy or other soils n
in lime.

Inoculation with soil from old fields of either
or bur clover greatly increase the yield of alfalfa
ing on sandy land.

The germ that causes tubercles to develop on
clover (meliltous) also causes tubercles to deve
the roots of alfalfa. Hence artificial inoculation
falfa is not necessary when it is grown on prairi
that has recently borne a crop of melilotus. Ar

culation of alfalfa is probably advisable even for irie soils when it is uncertain whether either the metus or alfalfa germs are present in great numbers.
n regions in Alabama where neither alfalfa, melilo- nor bur clover is extensively grown, inoculation of lfa is advisable. For this purpose one may use soil n old fields of either of these plants or inoculating terial prepared in the laboratory.

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OF THE

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AUBURN.

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ding and Grazing Experiments with Beef Cattle.

By

J. F. Duggar, Director and Agriculturist.

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The Bulletins of this Station will be sent free to any c the State on application to the Agricultural Experiment Auburn, Alabama.

FEEDING AND GRAZING EXPERIMENTS WITH BEEF CATTLE.

By J .F. DUGGAR, R. W. CLARKE, and JESSE M. JONES.*

Summary.

Using twenty young grade steers of the beef breeds, the following comparisons of foods were made: Cotton seed with cotton seed meal (Lots II and I); sorghum hay with a mixture of cowpea and sorghum hay, (Lots III and II); sorghum hay with shredded corn stover (Lots III and IV).

The feeding period covered 84 days, in addition to preliminary feeding. In all rations a small proportion of corn chop was used. As much grain was fed as the appetites and health of the steers permitted. As much roughness was fed as the steers would eat.

The average daily gain per steer was as follows:

With cotton seed and cotton seed meal.......2.23 lbs.
With cotton seed and mixed cowpea and sorghum hay ....1.93 lbs.
With cotton seed and sorghum hay..........1.19 lbs.
With cotton seed and shredded corn stover.... .98 lbs.

---

*R. W. Clark was Assistant in Animal Industry from September, 1899, to January, 1903, when he was promoted to a professorship in the Utah A. & M. College. Jesse M. Jones occupied the same position from January, 1903, to April, 1904, when he resigned to engage in farming in Alabama. These gentlemen had immediate charge of the experiments during the periods indicated. The Director is responsible for the plans of the experiments and the preparation of this Bulletin.

To produce one pound of increase in live weigh
was required of concentrated food, "grain," with
ton seed meal rations and sorghum hay, 4.82 lbs
the mixed hay and cotton seed ration, 5.41 lbs.; w
sorghum hay and cotton seed ration, 8.12 lbs.; w
corn stover and cotton seed ration, 9.41 lbs.

The amounts of roughness required to produ
pound of gain were, respectively, 6.56, 6.85, 11.
10.23 pounds. The cotton seed meal ration affor
largest per cent. of dressed meat.

A decline in the price of cattle while the expe
was in progress reduced the margin between the
and selling prices to less than six-tenths of a
pound, a margin usually too narrow for profitab
ing. On the basis of the very high prices of foo
prevailing in the winter of 1903-4, there was with
ton seed lots a profit during the first 56 days of
periment, but a loss after this time with all lots
account be taken of the manure.

On the basis of moderate prices of feed, Lot II
at a profit for 84 days. With low prices of food,
II, and III afforded a profit, in addition to the m

The profit in feeding beef cattle is made, not
ducing new growth at less cost per pound than
for, but in the increased value of the original
due to fattening. A margin of one cent per pou
tween purchase price and selling price is desirab

About 7 pounds of raw cotton seed was fed
daily ration without injury to the health of the
steer.

Account was kept of the cost of food consu
three grade or crossbred steers. Up to the avera
of 24.3 months the average steer consumed $18.39
of skim milk, grain, hay, and pasturage, of

at the first year's food cost $10.45, and that of the
d year $7.94. At 24.3 months, the average weight
67 pounds, worth at 3 cents per pound, $26.01. The
ge cost of food per pound of gain up to this age
.12 cents.
feeding calves rice meal proved decidedly inferior
n meal. When inferior shredded corn stover was
calves, 37 per cent. of it was refused, and when
shredded corn stover was fed freely to steers, 44
nt. of it was rejected. The waste in feeding coarse
um hay, slightly moulded, to steers, averaged 20
nt.
ersey calf, kept stabled until 6½ months old, pro-
manure (with accompanying bedding) at the rate
pounds per day.
rling steers, kept in a barn, averaged a daily pro-
n of 20 pounds of manure per day, exclusive of
ng.
rling steers on rye pasture alone gained 1.67 lbs.
per head.
de calves made on pasture alone an average daily
f .72 of a pound, or 151 pounds per season. Grade
ng steers made an average daily gain of 1.43 lbs.
y, or 307 pounds per season, on native pasturage
or 91 pounds of live weight per acre. This was
lent to a rental of $2.73 per acre for the land.
co-operative experiment made on an unimproved
land pasture, in Macon county, Alabama, a study
ade of the rate of growth of scrub cattle that re-
no food, even during winter, subsisting entirely
tive pasturage and the winter range, and other-
managed in the most primitive manner.
ring a pasturage season of 7 months the average
in live weight and percentage of increase as com-
with weight in the spring, were as follows:

Mature cow, nursing calves, 59 lbs., or 8 per c
Heifers (2 years old, etc.), 172 lbs., or 39 per c
Yearlings, male and female, 103 lbs., or 38 per c
Sucking calves, 141 lbs., or 51 per cent.
Young steers and bulls, 149 lbs., or 35 per cen

Young steers weighed for two pasturage sea succession increased in weight 42 per cent. as ye and 44 per cent. as two-year-olds.

On the winter range, cattle of all ages becan thin, and in the opinion of the writers, it woul been highly profitable for the owner to have s them with hay and other food during the winter.

The principal essentials to the profitable pro of beef cattle in Alabama are the use of pure-bre of the beef breeds, the economical production of pecially from the leguminous plants, the substitu this hay for a part of the grain ration, and an in study of the best methods of handling and ma cattle.

Feeding Experiment With Grade Steers

The steers used in this experiment consisted o teen head, bought at Starkville, Mississippi; and c head raised on the Station Farm at Auburn. Th issippi steers were sired by a Shorthorn bull w 1700 pounds, and were out of native cows, abo fourth of the steers showing strong evidence of blood. These streets were between two and thre old when bought. They reached Auburn Nover 1903. The three steers raised on the Station Fa sisted of a Red Poll grade, an Angus grade, and a bred Holstein-Shorthorn.

From November 5 to November 20 the entire lot of twenty steers subsisted on a pasture where frost had killed most of the grass on October 24. November 20 they were placed on a bare lot and the feeding of grain, (chiefly cotton seed), and sorghum hay was begun. For the first week they received only two pounds of grain per head daily, which was evidently insufficient. This amount was gradually increased. Throughout this time as much sorghum hay was fed as they would eat.

Our experience with these steers confirms conclusions previously drawn that the feeding of grain to animals intended for slaughter the same winter should begin earlier in the fall than is usual or as soon as the pastures begin to fail. November and December are months in which cattle on pasture shrink rapidly, and doubtless a little grain at this time, even while the cattle are on pasture, will avoid this source of loss.

During the entire time of the experiment each lot of cattle received as much forage as it would consume. The kinds of forage fed to each lot are stated below. An effort was made to make each lot of steers consume approximately the same amount of grain or concentrated food. However, this was found impracticable, but the amounts for the different lots were kept as nearly identical as the appetites and health of the animals would permit.

The forage was fed in racks above the grain trough and was not cut, nor was any of it mixed with the grain ration except such as dropped into the grain trough from the rack above.

It is believed that there would have been an advantage in cutting a small part of the hay and mixing it with the grain. Feeding of both grain and hay was done twice a day. Salt was accessible constantly, and twice a day the steers were driven to a pond for water. The water

supply was not satisfactory, and during cold weathe
steers would not drink sufficient water. The feeding
done under a rough shed covered with boards and
tens, and boarded up on the north side. The south
was left open and each lot of steers had at all time
choice between remaining under shelter or sta
in the small lots located on the south side of the fee
pen. The lots were on a steep, dry, sandy and stony
side, well drained, and never became deep with
Even in wet weather the steers seemed to prefer
lot to the shed.

The figures, which are not all on the same scale,
the steers as they appeared at the end of the experi

The steers were charged with all of the forage pu
to the rack, and what they failed to eat was used as
ding. The amount of this refused material was d
mined at several times and the average results are s
elsewhere.

RATIONS FED.

The object of this experiment was to compare,

(1) Cotton seed with cotton seed meal. (Lot II
Lot I.)

(2) Sorghum hay with a mixture of cowpea hay
sorghum hay. (Lots III and II.)

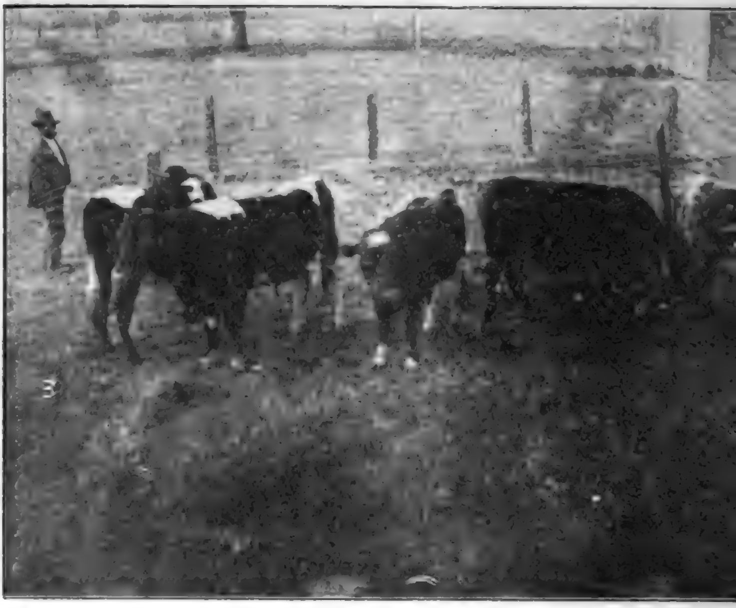
(3) Sorghum hay with shredded corn stover. (
III and IV.)

All cotton seed was uncooked.

On December 3 the twenty steers were divided
four lots, each containing five steers. In making th
vision both the weights of the steers and their indiv
conformation were used as a basis for the divisio
is believed that the lots were very much alike in av
quality as well as in weight. The weights of Lots
III, and IV on December 9 were respectively, 3878,
3858, and 3889 pounds.

Lot I. Fed cotton seed meal, corn chop, and sorghum hay.

ot II. Fed cotton seed, corn chop, and a mixture of cowpea and sorghum hay.



Lot III. Fed cotton seed, corn chop, and sorghum hay.

Lot IV. Fed cotton seed, corn chop, and shredded corn stov

ıe interval from December 3 to December 9 was con-
ɾed as a preliminary period, and during this time
lot was fed on the kind of food which it was to re-
e throughout the experiment.

ıe experiment proper began on December 9, and con-
ed for 84 days, or three periods of 28 days each.
ing all periods the feed for any given lot was the
e in kind and nearly the same in amount, the latter
g determined entirely by the health and appetite of
steers.

ıe weight of each steer was determined at the begin-
of the experiment by three weighings made on three
essive days. Similarly, the final weight was the av-
e of three daily weighings, March 1, 2, and 3, 1904.

ıe rations fed were as follows:

ɔt I—Cotton seed meal, two-thirds; corn chop, one-
l; sorghum hay.

ɔt II—Cotton seed, three-fourths; corn chop, one-
th: sorghum hay, one-half; pea vine hay, one-half.

ɔt III—Cotton seed, three-fourths; corn chop, one-
th: sorghum hay.

ɔt IV—Cotton seed, three-fourths; corn chops, one-
th: shredded corn stover.

s much of each kind of forage was fed as the animals
ld consume without excessive waste. The average
unt of forage wasted was as follows:

ɔt I—Sorghum, 17.1 per cent.
ɔt II—Sorghum and cowpea hay, 20.7 per cent.
ɔt III—Sorghum, 23.5 per cent.

ɔt IV—Shredded corn stover, 44.2 per cent.

will thus be seen that the waste of hay was about
ifth of the amount fed, while the waste of shredded
was more than double that of hay. This wasted
, as well as that consumed, was charged against the
s.

A considerable part of the surghum hay had p through a heat in the barn, and was somewhat dis ed and slightly moulded. It was all coarse, having grown in drills and cut after the seed had colored. cow pea hay, which constituted half of the roughne to Lot II, was not pure cow pea hay, but consis cow pea hay, 61.5 per cent.; crab grass, 24.7 per weeds, 7.8 per cent.; dirt, (sand, etc. raked up hay), 6 per cent.

The corn stover was bright and of fairly good qu It had never been baled. The corn chop wa coarsely ground to serve the principal purpose for intended, viz., to mix with the cotton seed in or increase the palatability of the seed. Indeed, the used during the last three weeks of the experimen slightly moulded and not relished, which may part count for the relatively slow gain made at that tim foods used were charged at the following prices, are cost prices for purchased articles, and for grown forage a figure somewhat above the cost o duction:

Cotton seed, per ton	$14.00
Cotton seed meal, per ton.........	22.00
Corn chop, per ton	26.00
Cow pea hay, per ton	10.00
Sorghum hay, per ton	6.67
Shredded corn stover, per ton....	4.00

The following table gives by periods the av amount of grain and of roughness consumed b steers in each pen, the average weight per steer beginning of each period, the average gain per ste day and per 28 days, and most important o the amount of grain and of roughness required to one pound of increase in live weight. It also gi summary of results for the first two periods (56 and for the entire experiment (84 days):

Average results of feeding experiment with steers, 1903-04.

Grain.	Rough-ness.	Chief food.	Avg. wt. per steer beginning	Avg. gain per steer in 28 days.	Avg. daily gain per head	Food per lb. of gain. Grain.	Food per lb. of gain. Rough-ness.
			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Period I—Dec. 9-Jan. 6:							
10.88	......	C. S. M. & corn	776	83.4	2.97	4.10	5.06
......	13.3	sorghum.					
10.41	......	Cotton seed,	783	63.2	2.25	5.15	6.36
......	12.9	sorg. & pea.					
9.72	......	Cotton seed,	772	58.2	2.08	4.66	6.15
......	12.8	sorghum.					
9.46	......	Cotton seed,	778	55.0	1.96	4.81	4.71
......	9.3	stover.					
eriod II—Jan. 6-Feb. 3:							
11.2	......	C. S. M.	859	65.4	2.20	4.79	6.38
......	14.8	sorghum.					
10.4	......	Cotton seed	846	66.4	2.38	4.37	5.45
......	12.9	sorg. and pea.					
10.1	......	C. Seed.	830	25.6	.91	10.99	14.14
......	12.9	sorghum.					
9.3	......	C. Seed	833	14.6	.52	17.91	18.90
......	9.9	stover.					
eriods I-II—56 days:							
11.	......	C. S. Meal	......	148.8	2.51	4.25	5.45
......	14.	sorghum.					
10.4	......	C. seed,	......	129.6	2.31	4.49	5.57
......	12.9	sorg. and peas					
9.91	......	C. seed,	......	83.8	1.50	6.60	8.59
......	12.9	sorghum.					
9.38	......	C. seed,	......	69.6	1.24	7.57	7.68
......	9.6	corn stover.					
eriod III—Feb. 3-March 3:							
10.4	......	C. S. Meal,	920	43.2	1.52	7.19	11.43
......	15.8	sorghum.					
10.5	......	C. seed,	913	32.2	1.15	9.09	12.02
......	13.8	sorg & cowpea.					
9.3	......	C. seed,	855	16.4	.58	15.89	23.74
......	13.9	sorghum .					
8.9	......	C. seed,	849	12.8	.45	19.43	24.06
......	11.0	stover.					

Three Periods—84 days:

Lot No.	Average daily ration per steer.			Avg. wt. per steer beginning.	Avg. gain per steer in 28 days.	Avg. daily gain per head.	Food of
	Grain.	Roughness.	Chief food.				Grain.
				Lbs.	Lbs.	Lbs.	Lbs.
I.	10.8	......	C. S. meal,	......	192.	2.23	4.8
	......	14.6	sorghum.				
II.	10.43	......	C. seed,	......	161.8	1.93	5.4
	......	13.2	sorg. and peas.				
III	1.70	......	C. seed,	......	100.2	1.19	8.1
	......	13.2	sorghum.				
IV.	9.22	......	C. seed,	......	82.4	.98	9.4
	......	10.	corn stover,				

The most important portion of the above tables is summary giving the results of 84 days. From this observe that to produce one pound of increase in weight required:

	Grain.	Ro ne
Lot I, fed cotton seed meal, sorghum hay, etc...	4.82	
Lot II, fed cotton seed, cow pea and sorghum hay, etc	5.41	
Lot III, fed cotton seed, sorghum hay, etc.	8.12	1
Lot IV, fed cotton seed, corn stover, etc...	9.41	1

This clearly indicates the superiority of cotton meal compared with an equal weight of cotton seed; superiority of mixed cow pea and sorghum hay sorghum hay; and the great advantage of the ration taining cow pea hay as compared with those in which roughness consisted of sorghum or corn stover.

In rapidity of gains the rations stand in the s rank. The average daily gain per steer was as follo

Lot 1, cotton seed meal, sorghum, etc........2.23
Lot II, cotton seed, cow pea and sorghum, etc.1.93
Lot III, cotton seed, sorghum, etc............1.19
Lot IV, cotton seed, corn stover, etc.......... .98

EFFECT OF FEED ON QUALITY OF STEERS.

ie steers were sold in the lots at Auburn to Phillips & ermann, Packers, Birmingham, Alabama.

aturally there was considerable individual difference een the steers, so that the differences in the price ıpon each by the packers are not entirely chargeable ie food used.

ie packers' estimate of the value of the steers fed on different rations is shown by the following table, ig the selling prices.

Prices of steers when sold.

No. worth 3½ cents.	No. worth 3¼ cents.	No. worth 3 cents.	Total value of lot.	Principal foods fed.
3	2	..	$164.47	C. S. meal, sorghum.
5	..	..	166.25	C. seed, pea. and sorg.
..	2	3	134.29	C. seed, sorghum.
2	1	2	139.55	C. seed, stover.

hen sold Lots I and II were judged to be of nearly l quality, and in this respect far superior to Lots III IV. The more nitrogenous (narrower) rations af- ed the more rapid fattening and the higher quality ıdged by the eye. Judged by percentage of dressed ht or shrinkage during shipping from Auburn to ningham, the steers fed on cotton seed meal (Lot I) superior to Lot III, fed on cotton seed and the same hness. Taking the weights at Auburn as the live hts, and comparing them with the amount of dress- ıeat obtained in Birmingham, we find that Lot I, on on seed meal and sorghum, netted 54.5 per cent.; Lot

II, on cotton seed and mixed hay, netted 51 per
Lot III, on cotton seed and sorghum hay, netted 5
cent.; Lot IV, on cotton seed and corn stover, nett
per cent.

In other words, on this basis alone, the packer
have afforded to pay a premium of one-fourth c
pound gross for Lot I, in comparison with Lot I
is but fair to add that if live weights in Birmi
could have been ascertained the percentages of
meat would doubtless have ranged considerably

FINANCIAL RETURNS.

For 56 days.—The cattle cost $2\frac{3}{4}$c per pound
vember. No charge is here made for freight, sin
fraction of a carload this was a very heavy exper
head, and since, moreover, the few Alabama catt
could have been had without any freight charges
have cost no more near home than was paid f
larger and more uniform lot of cattle in Miss
During the period between the purchase of these
in November, 1903, and their sale, in March, 190
packing house in Birmingham, Alabama, the pr
cattle fell. The estimated decline in the price o
of this grade was about $\frac{1}{2}$c per pound. Hence,
normal conditions and with a market neith
vancing nor declining, we should have realized $\frac{1}{2}$
per pound than the cattle actually brought, which
have given a fair profit on each of the four lots.

The price paid in our lots at Auburn was $3\frac{1}{2}$
per pound for the best ten steers, $3\frac{1}{4}$ cents per
for the five steers ranking next, and 3 cents per
for the five poorest steers.

Since the gains made by most of the steers wer
unsatisfactory during the third period, and since

believed to have been largely due to the inferior quality (mouldiness) of the corn chop purchased, we have calculated the financial returns at the end of 56 days' feeding, as well as at the end of 84 days' feeding.

For the 56 days embraced in the first two periods of the experiment, the financial results were as follows:

Lot I:		
To 3878 lbs. live weight, at 2¾c..........	$106.64	
To 3948 lbs. sorghum hay, at $6.67 per ton	13.16	
2054 lbs. cotton seed meal, $22 per ton	22.60	
1025 lbs. corn chop, $26 per ton........	13.33	
	155.73	
By 4602 lbs. live weight, at 3½c and 3¼c		$153.69
Loss on 5 steers in 56 days		1.84
Lot II:		
To 3915 lbs. live weight at 2¾c	$107.58	
To 1805 lbs. cowpea hay, at $10 per ton..	9.02	
1805 lbs. sorghum hay, at $6.67 per ton	6.02	
1940 lbs. cotton seed, at $14 per ton....	10.88	
970 lbs. corn chop, at $26 per ton.....	12.61	
	146.11	
By 4563 lbs. live weight at 3½c.........		159.71
Gain on 5 steers in 56 days...............		*13.60*
Lot III:		
To 3858 lbs. live weight, at 3¾c..........	$106.10	
To 3608 lbs. sorghum hay, at $6.67 per ton	12.03	
1844 lbs. cotton seed, at $14 per ton....	12 91	
923 lbs. corn chop, at $26 per ton....	12.00	
	143.04	
By 4277 lbs. live weight, at 3¼ and 3c..		$132.40
Loss on 5 steers in 56 days		10.64
Lot IV:		
To 3889 lbs. live weight, at 2¾c	$106.95	
To 2676 lbs. shredded corn stover, at $4..	5.35	
1756 lbs. cotton seed, at $14..........	12.29	
878 lbs. corn chop, at $26............	11.41	
	136.20	
By 4237 lbs. live wt., at 3½, 3¼, and 3c		$138.78
Gain on 5 steers in 56 days		2.58

In this period of 56 days there is a profit of $
from the lot fed on a mixture of cowpea and sor
hay and cotton seed; a profit of $2.58 from the lot f
corn stover and cotton seed; a slight loss from Lo
the lot fed an cotton seed meal; and a considerabl
from the lot fed on cotton seed and sorghum hay.

For 84 days.—During the third period of 28 day
cattle in all lots made very slight gains, largely d
is believed, to the poor quality of the corn cho
during the last three weeks of the experiment. I
the unsatisfactory results of the third period g
reduce the financial returns for the entire experim
84 days.

Financial returns for 5 steers per lot for 84 days
low, medium, and high prices of foodstuffs.

	Low.	Medium.	Hi
Cotton seed, per ton	$10.00	$12.00	$14.
Cotton seed meal per ton	18.00	20.00	22.
Corn chop, per ton	20.00	23.00	26
Cowpea hay, per ton	5.00	7.50	10.
Sorghum hay, per ton..	4.00	5.00	6.
Shredded corn stover, ton	2.50	3.25	4.

	Dr.	Cr.	Dr.	Cr.	Dr.
Lot I					
By 5 steers, selling price..		164 47	......	164.47	....
To 5 steers, bought at 2¾c.	106 64	......	106 64	......	106 64
To food fed	55.55	......	64 03	......	74.55
Profit or Loss..........	**Profit**	**2.28**	**6.20**	**Loss**	**16.72**
Lot II.					
By 5 steers, selling price..	......	166 25	......	166 25	....
To 5 steers, bought at 2¾c.	107 58	......	107.58	....	107.58
To food fed..............	39.81		47 94	...	60 31
Profit or Loss..........	**Profit**	**19.86**	**Profit**	**10.78**	**0 64**
Lot III.					
By 5 steers, selling price..	......	134 29	......	134.29	....
To 5 steers, bought at 2¾c.	106.10	......	106.10	......	106 10
To food fed..............	36.56	....	44.38	......	53 24
Profit or Loss	**8.37**	**Loss** ..	**16.19**	**Loss**..	**25.05**
Lot IV.					
By 5 steers, selling price..	......	139 55	......	139 55	....
To 5 steers, bought at 2¾c.	106 95	......	106 95		106 95
To food fed..............	29.50	......	32.99	....	41.38
Profit or Loss	**Profit**	**3.10**	**0.89**	**Loss**..	**8.78**

At the abnormally high prices of feed prevailing dur-
g the past winter, there was a financial loss with every
: of steers fed for 84 days. On a basis of medium
ices for food stuffs on the farm, Lot II, fed on mixed
wpea and sorghum hay, cotton seed, and corn chop,
forded a profit of $10.73, in addition to the value of
e manure, all other lots entailing a loss. With un-
ually low prices for food, every lot, except Lot III, af-
rded a profit, Lot II leading.

Whatever the price of feed the ration of mixed cowpea
d sorghum hay, cotton seed, and corn chop, was the
ost profitable.

As before stated, the fall in the price of fat cattle be-
een the time of purchase and of sale of these cattle
s about half a cent per pound. Had there been a sta-
nary, instead of a declining market, there would have
en an additional credit of at least $20 for each lot, or
fficient to make a profit on every lot except Lot III,
th food stuffs at the highest rating.

The production of beef in the South should be thought
as two distinct lines of business, which may be com-
ned on one farm or which may be entirely separate.
ese divisions are: (1) The growing of cattle from the
ne of conception until the animal has reached suffi-
nt size to be fed or finished for market, which is usu-
y when a grade of the beed breeds is between two and
ree years of age; (2) Feeding or finishing cattle, usu-
y between two and three years.

The first operation to be most highly profitable re-
ires an abundance of good pasturage and the almost
clusive reliance on foods grown on the farm, many
which could not be marketed at all unless first con-
rted into some form of livestock. In feeding operations
the other hand, use can often be made of purchased

food, especially of cotton seed meal. But even
ing cattle in winter there will be, as a rule, mo
profit to the farmer who utilizes crops raised on
land, for example, such foods as were fed in this
ment to Lot III.

It is generally recognized in states where i
numbers of beef cattle are fed for market from
months, that the profit consists chiefly in buyin
at a low price per pound and in selling them w
tened at a considerably higher price per pound.
common saying that the difference between the
and the selling price must be at least one cent pe
if the feeder is to obtain a satisfactory profit in a
to the manure.

Readers are cautioned against concluding tha
tain feeding operation is unprofitable simply
every pound of increase in live weight has co
than the same pound will sell for. The profit lie
in the enhanced value of every pound of the a
weight when feeding was begun, an increase in va
to the superior quality (or degree of fatness) of
ished steer. The following example of a steer w
900 pounds when feeding was begun, may make
portant statement clearer:

	Dr.
To cost of feed, 100 days, at 12c per day..........	$12.0
By value of 200 lbs. increase in wt., at 3½c........	
By increased value of original wt. 900 lbs. at 1c....	
Profit	$4.5
	$16.5

Here the feed cost more than the value of the
ed weight, or one pound of gain cost 6 cents, but
only 3½c. Yet this transaction was directly pr
to say nothing of the indirect profit from the

ınd from the utilization of food that would otherwise ıave been wasted.

The essentials to the highest profit in producing beef n Alabama are:

(1) The use of *thoroughbred* bulls of the beef breeds, nd, as soon as practicable, of dams having some beef lood;

(2) Abundance of good pastures;

(3) Economical production on the farm of cowpea, orghum, and other hay, and other foods needed in winering cattle;

(4) Intrusting the care of cattle to men who have tudied the business both of crop production and of eeding;

(5) Increased attention to marketing, including the aising of such numbers of beeves and of such quality as rill be worth shipping in carload lots to the best marets North or South; equitable freight rates; increased ppreciation on the part of local butchers of the superor value of well bred and well fattened beeves; and coperation in selling and shipping.

Health of the Steers.

This was good throughout the experiment, with the xception of an occasional case of scouring. The onclusion was drawn that for these particular lots of teers fed the specified kinds of roughness *ad libitum* it not safe to feed more than 7.5 pounds of cotton seed ıeal per day per steer to steers fed as those in Lot I, or more than 7.8 pounds of raw cotton seed to ot II, nor more than 7.5 pounds of raw cotton seed to ot III, nor more than 6.9 pounds of raw cotton seed Lot IV, which also received corn stover. Although orn stover is considered as constipating, yet cotton

seed, a very laxative food, had to be fed in
amounts with the above named roughness tha
fed with cow pea hay and sorghum, both of w
considered more laxative than the stover. Ou
ence that between 7 and 8 pounds is the maximu
ration of raw cotton seed which can be safel
steers, without inducing scouring, agrees clos
results at the Oklahoma Station, where the m
amount recommended was 8 pounds. (Okla. S
No. 58, p. 37).

Manure produced.—As elsewhere stated, th
spent far more time in the yards than under
and most of the manure dropped in the yards
due to drainage of lots.

About a week after the steers were sold, all
nure lying under the sheds and also the thick
manure extending out about six feet from th
was weighed before being hauled to the fields. T
amount hauled out from the four sheds aggrega
600 pounds of excellent manure. Making al
for that produced during the preliminary peri
estimated that about 27,000 pounds was produ
ing the 84 days of the experiment proper. I
words there was *saved* from the sheltered manu
16½ pounds of manure per steer daily, and d
the amount wasted was much greater. No bedd
used except the rejected stems of the hay and
Bedding should have been used. At $2.00 per
manure *saved* would average an additional c
$6.75 per lot.

Cost of Producing Beef.

To afford final conclusions as to the cost of
ing beef, it will be necessary to raise a numbe
mals in different years and under widely differ
ditions. However, the following data based o

sults with three steers is offered as a preliminary contribution to our knowledge on this subject.

An account was kept of the amount of food consumed by each of three calves from the age of two or three weeks until taken from the pasture at the end of the second grazing season, November 1, 1903, when we were offered 3 cents per pound for them by a local butcher. These animals were Dangus, a steer sired by a registered Angus, and out of a large cow that seemed to be about ½ Jersey; Toom, a steer sired by a registered Red Poll bull, and out of a large native cow, apparently a Shorthorn grade; Holstein, a cross-bred Shorthorn Holstein. All of these were dropped between September 21 and December 17, 1901. The history of these individuals is as follows: For the first one or two weeks after birth the calves, then belonging to private individuals, subsisted on the milk afforded by one teat of the dam. One of these calves, Holstein, dropped on the Station Farm, was never allowed to suck, but was fed for the first few weeks on whole milk or part whole milk. The account for food stands as follows:

Dangus—

	Dr.	Cr.
2009 lbs. skimmed milk, at ¼c	$5.02	
172 lbs. bran and corn meal, first winter, at 1c	1.72	
214 lbs. leguminous hay, first winter, at ½c	1.07	
180 lbs. grain, first spring at 1c	1.80	
Eight months' pasturage at 25c	2.00	
294 lbs. cotton seed, second winter, at ⅝c	1.84	
132 lbs. cotton seed meal and wheat bran, second winter, at 1c	1.32	
399 lbs. hay, second winter, at 1-3c	1.33	
86 lbs. green rye, at ⅛c	.11	
8½ months' pasturage, at 30c	2.55	
To cost of food up to age of 25 months	18.76	
By weight at 25 months (Nov. 1, '03) 888 lbs. at 3c		26.64
Excess of value over cost of feed	7.88	
	$26.64	$26.64

Cost of food per pound of live weight, 2.11c.

Toom (1/2 Red Poll)—

	Dr.
2100 lbs. skim milk, at ¼c	$5.25
131 lbs. wheat bran, first winter, at 1c	1.31
248 lbs. rice meal, first winter and spring, at ⅝c	1.55
311 lbs. leguminous hay, first winter, at ½c	1.55
8 months' pasturage, at 25c	2.00
361 lbs. cotton seed, second winter, at ⅝c	2.25
180 lbs. wheat bran and cotton seed meal, second winter, at 1c	1.80
484 lbs. sorghum hay, second winter, at 1-3c	1.61
86 lbs. green rye, at ⅛c	.11
8½ months' pasturage at 30c	2.55
To total cost of feed to 25 months	19.98
By 848 lbs. live weight, at 3c	
Excess of value of steer over cost of feed	5.46
	$25.44

Cost of food per pound of live weight, 2.35c.

Holstein-Shorthorn—

1554 lbs. skim milk, at ¼c	3.88
144 lbs. wheat bran and corn meal first winter, at 1c	1.44
150 lbs. leguminous hay at ½c	.75
8 months' pasturage, at 25c	2.00
374 lbs. cotton seed, second winter, at ⅝c	2.35
200 lbs. wheat bran and corn meal, 2nd winter, at 1c.	2.00
393 lbs. corn stover, second winter, at 1-5c	.79
51 lbs. vetch hay, second winter, at ½c	.26
84 lbs. green rye, at ⅛c	.11
8½ months' pasturage at 30c	2.55
27 lbs. cotton seed meal at 1.1c	.30
To total cost of feed to 23 months	16.43
By 865 lbs. live weight at 3c	
Excess of value over cost of feed	9.52
	$25.95

Cost of food per pound live weight, 1.9c.

From the above financial statement, it will b
that at the high prices of recent years, the total a
cost of food eaten by each animal from the age of
four weeks until 24.3 months old, averaged $18.3

that the value of the average steer at this age, weighing 867 pounds, was $26.01. This gives an average difference of $7.62 between cost of food and selling price, and must cover the cost of the calf at 2 to 4 weeks old, and other items of expense.

A much more favorable financial showing could have been made had not each of these steers been used in feeding experiments during each of two winters. There was no spcial effort to grow the animals as economically as possible when economy conflicted with experimentation as to the comparative value of foods. It is planned to grow in future a lot of grade beef calves with the primary object of producing beef as cheaply as the conditions at Auburn permit, and we are confident that with this end in view the cost can be greatly reduced below the figures given above by the following changes in the method of handlng the animals:

(1) By decreasing the amount of grain in winter and the substitution for it of leguminous hay and winter pastures.

(2) By the use of cheaper grain food, chiefly cotton seed.

(3) By causing the calves to be dropped after Christmas and keeping them only two winters if they are ready for market.

In order to make it easier for each reader to draw his own conclusions from the data above and to place his own local prices on the foods used, the following summary of the average amounts of food consumed per animal up to the age of 24.3 months, has been prepared.

Average amount of food consumed by grade
from age of 2 to 4 weeks to age of 24.3 months.

First year—

1888 pounds skim milk.
258 pounds grain.
225 pounds hay
8 months' pasturage.

Second year—

480 pounds grain, chiefly cotton seed.
1276 pounds sorghum hay and corn stover.
8½ months' pasturage.

From the above detailed data previously not
learn that the average cost of feed and pasturag
steer up to the age of 24.3 months was $18.39. (
the cost incurred during the first year for calves d
in the fall was $10.45; the cost of food and pastur
second year was $7.94.

The average cost of food per pound of live weig
2.12 cents, which cost could have been reduced
prime object in feeding these animals had cont
been the cheapest production of beef.

RICE MEAL VERSUS CORN MEAL FOR CALVES

Calves dropped in the fall of 1901 were used
experiment. They were grades of the beef breeds.
calf was fed a moderate ration of skim milk, a
lespedeza (Japan clover) hay as it would eat,
much of the grain mixture named below as it wo
without waste. The calves were first fed for nea
months on the ration which each was to receive
the experiment proper.

During these two months the amount of grai
was small, and especially during this time the ri

oved decidedly inferior in palatability to the corn eal. Indeed, it was impossible to make the calves eat fficient of the rice meal, so that it became necessary to e wheat bran as one-third of the weight of the rice eal ration, and of course wheat bran likewise constited one-third of the corn meal mixture.

The experimental period proper extended from Januy 1 to April 2, 1902, a period of ninety-one days. The tailed records for each calf are given in the table bew:

Rice meal versus corn meal for calves.

Name.	Grain, lbs.	Hay, lbs.	Skim milk, lbs.	Live wt. Jan. 1. Lbs.	Gain, lbs.	Breed.
e meal lot—						
Toom	153	237	1620	180	152	½ Red Poll
Foxella	252	300	417	195	137	¾ Angus
Total	405	537	2037	375	289	
rn meal lot—						
Andrew	261	306	475	192	150	¾ Angus
Dangus	138	214	1609	125	200	½ Angus
Total	399	520	2084	317	350	

The calves receiving rice meal made an average daily in per head of 1.6 pounds, while the lot eating corn eal averaged 1.9 pounds per head.

To make one pound of increase in live weight, the folwing amounts of food were needed:

	Rice meal.	Corn meal.
s. grain required to make 1 lb. of gain...	1.40	1.24
s. hay required to make 1 lb. of gain....	1.85	1.49
s. skim milk required to make 1 lb. gain.	7.04	5.70

From the figures given above it will be seen that meal was decidedly superior to rice meal in giving rapid growth, and in requiring a smaller amount o per pound of growth. Corn meal is also superior in position and palatability. The rice meal used evid consisted partly of ground rice hulls.

After an experience of five months in feeding rice to calves, we are led to the conclusion that it is n especially desirable food for calves. However, the made by these calves on rice meal indicate that whe price is very much cheaper than that of corn that i be thus used. A briefer experience in feeding rice suggests that it may be found to be a very desirable for calves, as also we have found it for hogs.

Shredded Corn Stover versus Sorghum Ha

During the winter of 1902-03 an experiment w gun to determine the relative values of shredded stover and sorghum hay, using yearling cattle, m which were grades of the beef breeds. The exper was interrupted by sickness of two of the animals, was not due to the feed. In the fifty days before th terruption the rate of daily gain was much greater the sorghum lot than with those fed the corn stove latter was of medium to poor quality and was deci unpalatable.

Of the corn stover offered, 37 per cent. remaine eaten in the troughs, although this food was fed in limited quantities as to make the animals consu large a proportion of it as possible. During a pa the time the stover was sprinkled with brine, but th not noticeably increase its palatability.

The sorghum was eaten clean. At first it was cu short lengths, but this was found to be unnecessar

yearlings consuming a bright good grade of sorghum hay fed whole as well as when cut. The grain ration fed in connection with both the stover and the sorghum hay consisted by weight of four parts cotton seed, one part cotton seed meal, and one part wheat bran, a very satisfactory combination.

MANURE MADE.

Manure from a young calf.—A Jersey heifer calf, dropped October 15, 1901, was kept in a box stall from November 3 to April 30, 1902, except that for one day every two weeks she was allowed to run in a lot, and the manure for this day was thus lost. Pine leaves were freely used as bedding, and in more liberal quantity than is customary.

The total amount of manure, including bedding, as weighed a week after the close of the experiment was 1645 lbs. produced in 176 days. This is about 9.4 lbs. of manure and bedding per day, which is a larger amount than would be obtained with the usual amount of bedding.

During this time this calf consumed 204 lbs. of wheat bran, 323 lbs. hay (chiefly lespedeza and crimson clover), 92 lbs. of whole milk, and 1191 lbs. of skim milk.

Assuming 6 lbs. of skim milk as equivalent to 1 lb. of grain, we have a total amount of feed eaten, equivalent to about 740 lbs. of grain and hay. Hence for every pound of air-dry food consumed there was produced about 2.2 lbs. of manure.

Manure produced by yearling beef animals.—Beginning January 17th, 1902, the combined liquid and solid manure dropped by six head of yearling cattle, most of which were grades of the beef breeds, was saved and

weighed daily. The arrangement for catching the
pings consisted only of the usual wooden manure g
and the use of pine leaves as bedding. The floors o
stalls were of clay, and hence there was some loss o
liquid manure from the four steers. The cattle had
taken from the barn for a short time twice a da
water, which represented the loss of such manure as
dropped during a daily period of about one-half h
From these statements it will be seen that the effort
rather to determine the amount of manure that the
mer could expect to save from cattle of this kind,
under shelter, than to determine from a scientific s
point the actual and exact weight of the excreta.

The results for the twenty-day period were as foll

Solid and liquid manure saved from 6 yearlings in 20 days, excluding bedding	
Bedding used	
Total manure per head daily, excluding bedding...	
Total manure per head daily, including bedding...	
Total cotton seed, cotton seed meal, and wheat bran fed	
Total sorghum hay and corn stover actually consumed	
Total food	
Pounds liquid and solid manure saved per pound of dry food fed	

At this rate six yearlings in one month would pro
3600 lbs. of manure, or, including bedding, about
tons. In other words, a beef animal weighing abou
lbs. would produce a ton of manure in about 3 mo

Grazing Yearling Steers on Green Rye.

For three weeks, beginning March 11, 1903, four
ling steers, averaging about 500 pounds in weight,
placed on a field of rye, sown on thin upland on the

farm at Auburn during the preceding September. re being placed on this pasture they had for several been accustomed to eating green rye and had been lowed to make the fill that usually occurs when cat- re first placed on green food.

e increase in live weight was 1.67 pounds per head lay.

e rye was about two feet high when the cattle were ed on it, and although too old and coarse to be as table as at a younger stage, yet it was eaten clean.

determine the increase in live weight made by oughbred and grade cattle of the beef breeds, weigh- were made throughout the pasture season for such animals in the Station herd as were kept continu- y on pasture. The following table gives first, the for five calves, grades of the beef breeds; and for mature cows, thoroughbreds and grades of the beef ds, for the time that they were kept continuously on ure.

Gains of Station beef cattle on pasture alone.

ame.	Breed.	Weight in spring.	Gain, lbs.	Days.	Average daily gain, lbs.
a	½ Red Poll	345	160	214	.74
us	½ Angus	340	152	214	.71
ein	Hol. short	315	177	214	.82
lle	Short horn	455	95	214	.44
lla	¾ Angus	370	135	214	.63
us 2nd	½ Angus	238	187	184	1.01
entina	Red Poll	1050	200	183	1.09
lle	Short-horn	1010	240	183	1.31
ness	Grade Angus	1045	185	183	1.01
y	Grade Angus	880	145	183	.78
y	Angus	855	245	183	1.34

From the above table it will be seen that the a
daily gain of calves having from 50 to 100 per c
beef blood, was .72 pound, and that the average
gain of thoroughbred and grade beef cows w
pounds.

The pasture was strictly unimproved, or in its n
condition, and consisted chiefly of old poor upland
too poor for cultivation, on which the principal g
lespedeza and broom sage.

In order to determine the amount of beef which
be produced from an acre of pasture, a portion of t
ture of the Alabama Experiment Station farm wa
ed off and four young steers were kept on it from
1 to November 1, 1903. The following table giv
breeding of the animals, their weight on April 1, a
gain made during the next seven months.

Gains made by four yearling steers from April 1 vember 1, 1903.

Name.	Breed.	Weight April 1st.	Weight Nov. 1st.	Gain on pasture.
Toom	½ Red Poll	590	848	258
Dangus	½ Angus	535	888	353
Holstein	Holst-shorthorn	555	865	310
Cull	Scrub	445	715	270

The area in this pasture was 13.11 acres, of
about 3.1 acres was covered by a dense growth of
and other timber. On this area the total increase
weight made by the four steers was 1191 pounds,
the rate of 91 pounds of increase in live weight fo
acre, including thickets. At 3 cents per pound,
equivalent to a rental of $2.73 per acre for the
tract, although, if cultivated, the rental value of t
tire tract would not have exceeded half this amou

Moreover, in the season of 1903, when rains were so avorably distributed for the growth of pasture grasses he steers were not able to consume the entire growth. Ve estimated that there was food enough for two more imilar steers. For three weeks in November this pasure supported seventeen two-year-old steers, without ther food.

The average daily gain per head for the three yearling teers with beef blood on pasturage alone was 1.43 lbs. nd the average gain for the pasturage season was 307 bs. per head.

GAINS MADE BY SCRUB CATTLE ON PASTURES.

Conditions of the experiment.—It seemed a matter of mportance to study the gains made by scrub cattle unimproved natives) during the grazing season. Hence n the spring of 1901, an experiment was begun in coperation with a farmer living in Macon county, Alaama, who every year pastures a large number of cattle f scrub or Jersey blood. One of the principal objects in iew was to ascertain what class of animals, or rather nimals of what age, made the most rapid gains, or rought the most profit to the dealer or stockman pasturng cattle.

The Station furnished the scales and its representative veighed the cattle several times each year. The pasture s so large and the cattle so wild and the stock so frequently changed by sales and new purchases that only or a few of the several hundred animals weighed are the ecords in any sense complete. However, by combining he results for the three years, we obtained averages which are believed to have some suggestive value. The pasture on which these cattle grazed consisted of old ields and swampy thickets with a small amount of switch cane. The principal growth relished by cattle

consisted of lespedeza, broom sage, crab grass,
grasses, and switch cane. This is strictly an un
ed pasture, no seed of any kind having been sow
It is probably an average native or unimproved
on sandy land. Most of it is made up of old fiel
that have been uncultivated for many years, an
areas recently thrown out of cultivation. The so
rank as poor sandy land, worth, perhaps, if in
tion, $3 to $6 per acre.

Relative gains during the pasturage season in g scrub cattle of different ages.

By averaging the results for the different year
found that during the portion of the pasturage
covered by our weighings the daily gain made by
ferent classes of stock for periods of 138, 183,
days (these being the respective intervals
weighings during the three years, were as follow

Daily gains made by scrub cattle on native pa alone.

9 cows averaged per day . . . .
14 heifers (300 lbs. and above) averaged . . . . .
7 yearlings, male and female, averaged . . . . .
4 sucking calves averaged . . . .
13 steers and bulls (above 300 lbs.) average . .

It was impracticable to make weighings early
in the spring and late enough in the fall to inc
entire pasturage season. However, we are c
that the period during which cattle made avera
was at least seven (7) months, or from April 15t
vember 15th. Hence, in order to make the
clearer we have calculated from the figures a
gains for a pasturage season of 210 days and th
are given below:

'ains made by scrub cattle during a season of 7 months on pasture.

	Lbs.		Value of increase at 2½c
[ature cows, sucking calves	59	......	$1.48
[eifers above 300 lbs............	172	......	4.30
'earlings, up to 300 lbs	103	......	2.58
ucking calves	141	......	3.52
'oung steers and bulls	149	......	3.73

It is obviously unfair to compare the mature cows 'ith the other animals, since the slight gains made by 1em are due in large measure to the fact that they had ursing calves at their sides. Excluding the cows, we nd that the largest gains were made by the heifers that t the beginning of the season weighed more than 300 os. It is notable that the heifers should have beaten he steers of corresponding weight. The sucking calves 1ade considerably greater gains than did the yearlings, ut it cannot of course be said that sucking calves are 1ost profitable stock for grazing, for the reason that the razing of this class of animals necessitates supporting he dam, whose gain is slow.

A more accurate idea of the relative profit of grazing hese different classes of animals may be obtained by scertaining what per cent of increase, as compared with he weight in the spring, is made by the average animal f each class during the season of abundant pasturage.

'ercent increase during pasturage season of 7 months.

	Avg. wt. in spring.	Per cent. increase.
'ows, suckling calves.........	615	8
Ieifers	440	39
'earlings, male and female....	269	38
ucking calves	272	51
teers and bulls	428	35

According to this showing, if scrub cattle are bought nd sold at the same price, the investment should return gross profit of 39 per cent. with large heifers, 38 per ent with yearlings and 35 per cent. with steers. Since

the selling price per pound is considerably al purchase price, the showing is still more fa Of course, from this must be deducted a numbe penditures, including interest or rent and los death. If these figures are representative they that either one of these three classes of scrub ca be pastured at practically the same profit.

However, for cattle to be kept over winter feed except the range the losses by death are with the calves and yearlings than with older To form a better idea of the weights of these sc tle, the reader is referred to the table in the App

Annual growth made by scrub cattle under ra ditions.—It would be of interest to ascertain the from year to year and the average gains for a year under this system of maintaining scrub cat out any food in winter. From causes alluded our records on this point are fragmentary, the s ing constantly changed.

Ten head of cows averaged an annual increase weight of only twenty-four pounds, this poor being attributable, of course, to the calves th suckled. The history of five young steers, wei intervals for two years is of interest as show effect of age on the rate of growth of very youn The following table gives the details:

Growth made by young scrub steers in two ye

Steer No.	Weight first spring.	Gain first year.	Gain second year.	Gain two years.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
11	218	120	170	290
56	238	128	190	318
57	326	168	172	340
67	304	88	170	258
84	234	64	178	242
Average				

From this table we see that the average gain p per year was 145 pounds, worth at 2½c per $3.67. The increase made by these young ste

during the first year 42 per cent over their weights in the spring. The same steers made during their second year an increase of 44 per cent. over their weights of the second spring. In other words, there was little difference in the profits during the two years, in spite of the difference in the age.

Loss of weight by range cattle during winter.—The management of this herd of cattle included many matters, which in the opinion of the writers, were at fault, or could have been improved; for example, the almost exclusive purchase of scrub or grade Jersep cattle rather than the raising of calves from the owner's cows and sired by a thoroughbred bull of any of the beef breeds. Another great mistake in management, we belive, consisted in requiring the cattle to subsist throughout the entire winter without any food whatsoever except what they could obtain on the range from canebrakes, cotton stalks, corn stalks, etc. Since our weighing was not made until May of each year, when the cattle had been on pasturage for about a month, it is not possible to estimate exactly the amount of decrease in live weight occurring between the time that the fall pasturage failed and that the grasses put out in the spring.

Of 22 animals of all ages weighed October 1, 1901, at least a month before pasturage greatly deteriorated, and again weighed May 7, about six weeks after the pastures put out in spring, 64 per cent lost in weight during this period of six and a half months.

The losses in weight would have been much greater had our weighings been made about November 15th and April 1st.

It is believed that the shrinkage in live weight during the winter, the utter loss of all food obtained from pasture and range from October to May, and the considerable number of deaths during the winter, more than counterbalance the saving of feed, which is the only point of advantage claimed for this system. Our advice is to winter only so many cattle and those of such quality that it will be feasible and profitable to supply them with hay, if not with both hay and cotton seed, after the pastures or ranges fail in December, January, or February.

APPENDIX.

Individual weights, gains, and percentages of dressed weight of grade steers.

Lot No.	Name or Number of Steer.	Initial weight.	Gain: First 28 days.	Gain: Second 28 days.	Gain: Third 28 days.	Gain: Total 84 days.	Average daily gain.	Dressed weight.	Principal Food: Roughness.	Principal Food: Concentrate.
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	%		
I	Dangus	803	122	61	47	230	2.74	56.6	Sorghum	Cotton seed meal.
I	Daddy	877	83	90	40	213	2.54	54.3	Sorghum	Cotton seed meal.
I	42	832	88	75	44	207	2.47	55.7	Sorghum	Cotton seed meal.
I	153	733	52	26	19	97	1.15	55.4	Sorghum	Cotton seed meal.
I	308	633	72	55	64	191	2.27	49.3	Sorghum	Cotton seed meal.
I	Average	785	83.4	61.4	42.8	188	2.23	54.5		
II	18.	795	56	40	50	146	1.74	50.9	Sorghum and cowpea	Cotton seed.
II	53.	707	59	81	31	171	2.04	50.7	Sorghum and cowpea	Cotton seed.
II	91.	838	114	73	37	224	2.67	51.7	Sorghum and cowpea	Cotton seed.
II	222	795	70	60	30	160	1.90	50.6	Sorghum and cowpea	Cotton seed.
II	224	780	17	78	13	108	1.29	51.7	Sorghum and cowpea	Cotton seed.
II	Average	783	63.2	66.4	32.2	162	1.93	51.		
III	Holstein	797	21	39	13	73	.90	49.1	Sorghum	Cotton seed.
III	Roan	802	68	37	41	146	1.74	*	Sorghum	Cotton seed.
III	60	735	71	28	—3	96	1.14	51.5	Sorghum	Cotton seed.
III	84.	822	83	11	32	126	1.50	51.3	Sorghum	Cotton seed.
III	237	702	48	13	—1	60	.71	50.6	Sorghum	Cotton seed.
III	Average	772	58.2	25.6	16.4	100	1.19	50.6*		
IV	Toom	746	72	9	26	107	1.27	53.4	Corn stover	Cotton seed.
IV	10.	646	52	—3	13	62	.74	49.8	Corn stover	Cotton seed.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.04	52.6	Corn stover	Cotton seed.

Weights and gains made during the pasturage season by scrub cattle in Macon County.

		Age, years.	Year.	Days between weighings.	Weights in spring.	Gain in one pasturage season.	Daily gain.
	Cows 4 years and older						
68	....	10	1902	238	652	38	......
46	....	8	1902	238	536	82	......
121	....	4	1902	238	520	80	......
62	....	4	1902	238	586	40	......
68	.......(?)	8	1903	183	666	64	......
196	....	8	1903	183	638	84	......
189	....	4	1903	183	700	46	......
29	....	10	1903	183	626	36	......
	Average	......	....	......	615	59	.28
	Heifers above 300 lbs..						
71	....	2	1901	136	510	146	......
79	....	2	1901	136	360	122	......
58	....	1½	1901	136	310	118	......
81	....	1	1901	136	356	68	......
16	....	3	1902	238	408	112	......
22	....	3½	1902	238	472	146	......
107	....	3½	1903	183	542	232	......
107	....	2½	1902	238	418	152	......
194	....	2½	1903	183	542	88	......
187	....	2½	1903	183	600	188	......
197	....	2	1903	183	482	198	......
193	....	2	1903	183	428	192	......
51	....	2½	1903	183	398	148	......
101	....	1½	1903	183	342	176	......
	Average	......	....	......	440	149	.82
	Yearlings, up to 300 lbs						
76	....	1	1901	136	258	24	......
84	....	1	1901	136	234	86	......
36	....	1	1901	136	256	128	......
81	....	1	1901	136	356	68	......
114	....	1	1902	238	218	88	......
124	....	1½	1902	238	274	94	......
18	....	1½	1902	238	272	118	......
	Average	......	....	......	269	89	.49

Weights and gains made during the pasturage season
cattle in Macon County.

		Age, years.	Year.	Days between weighings.	Weights in spring.	Gain in one pasturage
	Sucking calves.					
40	....	½	1901	136	230	
131	....	......	1902	238	306	
12	....	1	1901	136	262	1
51	....	1	1901	136	293	1
	Average	......	....	......	273	1
	Steers above 300 lbs.					
96	....	3	1901	136	520	
73	....	2	1901	136	584	1
27	....	1½	1901	136	419	
38	....	2	1901	136	426	1
41	....	3	1901	136	486	1
67	....	1½	1901	136	304	
63	....	1½	1901	136	356	1
65	....	2	1901	136	477	1
87	....	2	1901	136	470	1
69	....	1½	1901	136	361	1
11	....	1½	1902	238	338	
40	....	1½	1902	238	304	
82	....	2½	1903	183	522	2
	Average	......	....	......	428	1

Files (Exp Sta)

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ALABAMA.

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute.

AUBURN.

The Mexican Cotton Boll Weevil.

BY

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Plant Physiologist and Pathologist.

MONTGOMERY, ALA.,
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1904.

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Auburn, Alabama.

*To be filled.

THE MEXICAN COTTON BOLL-WEEVIL.

BY EDWIN MEAD WILCOX.

Introduction.

In twenty years the Mexican cotton boll-weevil (*Anthonomus grandis* Boh.) has developed from a rather obscure species to one of supreme importance with respect to the production of the world's supply of cotton. The infested regions are taking desperate measures to destroy the pest or to adjust and modify the present methods of cultivation in such manner that cotton may still be grown at a fair profit in the infested regions. The recent appropriation of $250,000.00 by the Congress of the United States for the exhaustive study of the boll-weevil problem from all points of view has given to the boll-weevil a national importance.

It seems desirable to present to Alabama cotton growers our present information upon this very important subject together with the suggested methods of controlling the boll-weevil should it ever become established within the borders of our State. This bulletin may therefore be said to result from an application of the old adage, "forewarned is forearmed." No claim for originality is made as to the facts stated, but the reader is referred to the papers mentioned in the Bibliography at the close of the bulletin for the most recent original investigations of this subject. The facts given in the papers cited have been freely drawn upon in the preparation of this bulletin.

INTRODUCTION AND PRESENT DISTRIBUTION OF THE BOLL WEEVIL.

The boll-weevil probably crossed the Rio Grande river into Texas about 1892—at least that is the opinion of the

planters in that region. By 1894 it had spread
dozen counties in southern Texas bordering u
Rio Grande river and the Gulf of Mexico. At t
it was brought to the attention of the United St
partment of Agriculture; the Division of E
ogy commenced late during 1894 the investig
the weevil and has continued this investigation
present time. The Department of Entomolog
Texas Experiment Station has also rendered
aid in the investigation. The recent appropri
Congress has made it possible to concentrate u
boll-weevil problem the efforts of a large numbe
sons and the weevil is now receiving more attent
probably any other insect pest in the world.

Fig. 1. *Map showing the distribution over Texas and Lo*
the boll weevil at intervals since its first appearance
Bull. 45. Div. Ent., U. S. Dept. Agr.)

ne map shown as Fig. I presents graphically the
ent known distribution of the weevil as well as the
ance it has made over the area indicated since its first
earance in 1892. From a study of the insect's means
eaching new territory it has been estimated that
weevil will be at work throughout the entire cotton
of the South in 15 to 18 years. In Texas during
past ten years the weevil has made an annual ad-
e of about 50 miles.
aving this danger in mind and to prevent the ac-
ntal or intentional introduction of the pest into the
e the last Legislature passed the following law,
h is here quoted in full:

a act to prevent and prohibit the importation of from cotton affected with Texas boll weevil.

CTION 1.—*Be it enacted by the Legislature of Ala-a,* That no person shall import or bring into the e of Alabama any seed from any cotton affected with t is known as the Texas boll weevil, nor the seed any place where the cotton has been affected with boll weevil.

C. 2.—Any person who violates the provisions of ion 1 of this act shall be guilty of a misdemeanor, on conviction, shall be fined not less than ten dol- ($10.00) and not more than five hundred dollars 0.00). [H. 877. No. 559. Approved Oct. 6, 1903.]

gislation can, after all, however, do nothing more in ease than build up public sentiment and arouse inter- t in the weevil problem and if cotton planters permit weevil to become established in this State it will be esult of their own neglect. Planters and others will er a great benefit upon themselves and upon the e by promptly reporting and sending specimens of suspected boll-weevil to the Alabama Experiment ion. All such insects should be killed with chloro- or other means before being forwarded through mails and then be enclosed in tin or wooden boxes.

Amount of Damage Due to Boll-Weevil.

There is frequently a tendency to greatly exag
crop losses, but a very conservative estimate shov
the damage done by boll-weevil in Texas amour
nually to about $15,000,000. The loss in the we
fested counties of Texas is certainly fully one-half
crop. If we assume that the total cotton crop
United States has a value of $500,000,000 it will b
that when the boll-weevil is found throughout the
cotton belt the annual loss will be at least $250,0
annually. All these estimates are based upon th
ure of the planters to adopt any measures to che
spread of the pest or particularly to reduce the
of its damage. We shall see that there is much
that cotton may be grown at a profit in the infes
gions if the planters will adopt the modern meth
planting and cultivation suggested and urged
Bureau of Entomology of the Department of A
ture.

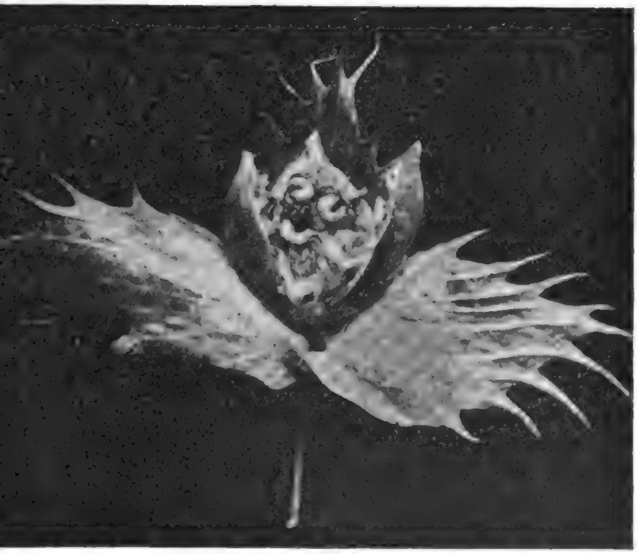
Life History of Insect.

Egg.

The female weevil deposits the egg in a
made by eating into either the square or boll.
cavities are made usually between the middle a
tip in the case of squares, but seem to occur at r
in the case of bolls. The length of the egg stage
vast majority of cases varies from 2 to 5 days.
been observed that but a single egg is usually dep
in a boll if the female is able to find bolls not pu
ed. This habit of selecting a fresh boll for th
position of each egg accounts for the large num
bolls injured by a single female. It is probable
single female may deposit as high as 200 eggs
the season.

LARVA.

[Th]e larva when it escapes from the egg is a delicate [whit]e grub about 1-25 of an inch long, and without legs. [(See] Figs. 2 and 3.) If it were not for the [brow]n head and mandibles the larva would be quite as [incon]spicuous as is the egg itself. In the squares the [larv]a probably molts but twice while growing, but it is [almo]st certain that in the bolls, and perhaps also in [squa]res, there is also a third molt.



Three large larvae in a boll. x¾. (Bull. 45, Div. Ent., U. S. Dept. Agr.)

[Du]ring the warmer parts of the summer it is probable [that t]he larval stage in the squares lasts not over 6 days, [but i]n colder weather the period is of course longer. [Light] frosts do not kill the larva in the bolls, and they [may] continue their growth and complete their develop[ment] after the occurrence of a frost.

In the bolls the larval stage last probably
longer and here 6 to 7 weeks is near the length
larval period.

As the boll reaches maturity the mature larva,
to 1-3 of an inch long, ceases feeding a
comes surrounded by a sort of cell compo
larval excrement mixed with the lint, etc.
in this cell the pupation and formation of th
occurs. The cells are shorter and thicker than
seeds, with which they are at times confused.

PUPA.

When the insects enters this stage it ha
the form of the adult, but its color is
white or cream. (See Fig. 3.) The pupa
lasts in squares on the average three t
days in warm weather, but may reach a maximu
days in cold weather. The pupal stage is certain
er in bolls than in squares, but no definite data
hand on this point.

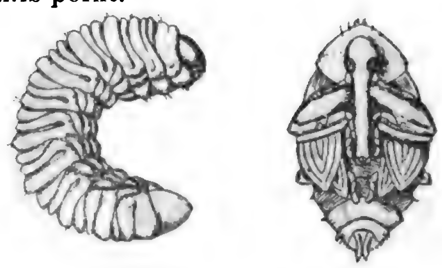


Fig. 3. *Larva, to the left, and pupa, to the right. x6.* (
Bull. 189, U. S. Dept. Agr.)

The final molt of the pupa requires about a ha

ADULT.

About 2 or 3 days are required for the adult to
the color typical of the species and to acquire s
strength to enable it to walk. The weevils m
much in size dependent largely upon the ques

available food supply . With the proboscis extended they vary from 1-8 to 1-3 of an inch in length and in the middle of the body are from 1-25 to 1-8 of an inch broad. (See Fig. 4.)

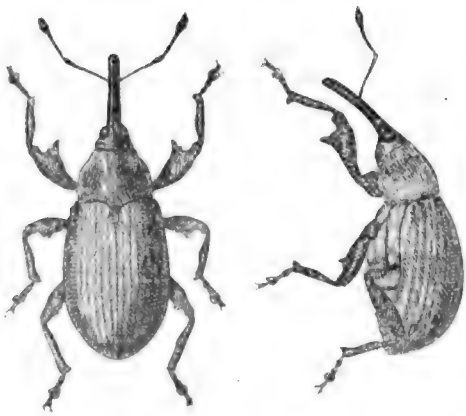


Fig. 4. *Mexican cotton boll weevil (Anthonomus grandis).* x3 (*Bull. 45, Div. Ent., U. S. Dept. Agr.*)

The color of the boll weevil varies with the size—the smaller weevils being darker brown and the larger weevils being light yellowish brown. The average color between these two extremes is a gray brown or dark yellow brown. The yellowish color of the larger specimens is due to the presence of numerous yellowish scales that are more conspicuously formed in large than small weevils. These scales, however, often become rubbed off, leaving the dark brown color of the chitin. The sexes, however, cannot be distinguished as is often supposed by any question of either size or color.

The average length of life of the adult weevils on squares is about 10 weeks for males and 9 weeks for females. On the bolls it is nearly 3 weeks for males, but only about 2 weeks for females.

Feeding Habits.

Until the females begin to oviposit the feeding habits of both sexes are alike. Bolls and leaves are seldom fed

upon so long as squares are available. The pu
from the outside is only large enough to admit th
boscis, to the tip of which the mouth parts are att
The principal part of the square eaten consists
anthers and pollen sacs. When these are reach
cavity is broadened out to give to the whole cavity
the shape of a flask.

The males are known to make on an average a
feeding punctures per day, though during the fir
days of adult feeding existence they may make a
as 6 to 9 punctures per day. They average, ho
about 3 punctures to a square, and hence really d
little damage. The males, unlike the females, mo
quently chose to puncture the square very near th

After the females begin to oviposit they eat less
square or from a single puncture than before. Si
we have said that as a rule a female oviposits bu
on a square and since most of her eating is done i
nection with oviposition, it becomes clear tha
amount of damage done by the females is much g
than that due to the males.

It has been demonstrated by experiment tha
American upland cottons are much less subject to
by the weevils than any others, and that the Eg
(Mit Afifi) cotton is more subject to attacks tha
other variety. It is now known also that the boll
has no food plant, native or cultivated, other tha
various species and varieties of cotton.

Number of Generations.

No hard and fast line can be drawn between th
ferent broods of the weevil—not even betwee
hibernated weevils and those of the first spring g
tion.

It is probable that in the southern part of Tex
broods occur between 1 May and 1 December—t
on the assumption that the average life cycle of a g
tion from egg to egg is about 42 days. In nor
Texas and probably also in this region not more
4 broods would occur.

Hibernation.

;ven after the cotton has been entirely killed by frost lt weevils may be seen moving about in the fields. southern Texas the weevil may hibernate as either ra, pupa or adult, but they most commonly hibernate the adult condition. The majority of weevils that cessfully hibernate over winter are those developed st in the fall—whose vitality was consequently not austed by oviposition or otherwise before the apach of winter.

he average hibernation period is from 1 December to pril, or about 4 months. Given a dry sheltered place as high as 1-6 of the weevils will live through the ter.

Dissemination.

he search for food or new squares is the principal ncy leading to the migration of the weevils from one ce to another. Prevailing winds may assist if these ır when the weevils are naturally most active, as does ır in Texas.

rtificial dissemination will take place most commonlong railways and water courses. The shipment of on baled or for ginning is nearly certain to mean oment of the boll weevil. And the same is true of oments of seed for planting and other purposes. Our te law already quoted (page 93) should receive the port of every person living in the State and having slightest concern for the welfare of the State. In ard to pests of this and all other types legislative ennent may develop public sentiment, but certainly can er replace it.

Methods of Control.

'he methods of control may roughly be divided into classes (a) natural, and (b) artificial.

Among the first group we mention in the first place climatic control. The factors of highest importance in determining the development, distribution and destructiveness of the boll weevil are temperature, precipitation and food supply. We have stated that the weevil has but a single food plant—the cotton—and it is remarkable how thoroughly adjusted to the condition of the food plant the weevil has become. Conditions favoring the growth of the cotton plant are also favorable to the development of the weevil.

High temperatures and abundant rainfall are the two climatic factors distinctly favorable to weevil development, and hence it is that at such times their injury is most noticeable. Rains tend to increase formation of squares by the cotton plant and the squares, we have seen, are the feeding places and oviposition structures for the weevils. Rains also indirectly favor weevil development by the injury they do to the natural enemies of the weevil.

Too heavy rains during the winter are very apt to kill many of the hibernating weevils and hence following a comparatively dry winter one would expect to see a larger brood of hibernated adult weevils appear in the spring than following a rainy winter.

Experiments have shown that overflows will not injure enough weevils to be of any great service. Even the larvae and pupae in equares that have been under water for some time were found to be uninjured. Adult weevils may float several days in the water and yet not be injured. It is very probable that the floating of adult and infested squares by means of high water will prove one of the most important natural agencies for widely distributing the pest.

PARASITES, PREDATORY INSECTS, AND DISEASES.

The very recent announcement by an officer of the United States Department of Agriculture of the discovery in Guatemala of an ant that preys upon the boll weevil has called forth renewed interest in this subject of parasites or rather predatory insects. However,

ems certain that the ant discovery has al- been overworked and its importance much ex- ated. Hunter & Hinds, 1904, say: "There is at nt, therefore, no promise of any considerable as- ice in the control of the weevil by any parasite now n. * * * Even should one be found which could : the weevil in some stage, it would probably still o be an efficient means of control. * * * "

tain predatory insects other than the Guatemalan nay serve to check the weevil, but the work of all insects combined is comparatively of little import- when compared with the cultural methods mention- low.

d there seems to be but little hope of securing a is parasite that will be of any service in killing ls. A study of the history and outcome of the use "chinch bug" fungus and later the grasshopper is shows how utterly impracticable any such meth- certain to be.

connection with the appearance of such an import- est as the boll weevil there is certain to be a host of s remedial and preventive measures suggested. It l be a waste of space to even mention all these nes here. Considerable attention has been devoted vising some method of spraying the cotton plants in of killing the weevils. We may for the present dis- any spraying scheme with a quotation from Hunter nds, 1904, who say: "Spraying of a field crop has been a success, and, unless entirely new methods ventually perfected, never will be of any practical tance."

course the suggestion made from time to time that substance may be mixed with the fertilizer which oe distasteful to the weevil when absorbed by the is absurd.

nas proven impossible to devise a machine that will e one to collect from the ground the fallen squares. d it is even more absurd to hope to find any sort of n that the boll weevil will not care to eat. There is it to the profitable variation in the cotton plant to duced by breeding and selection and there is cer-

tainly no hope of securing a strain of upland cott will prove resistant to the boll weevil, or to any o sect.

Cultural Methods.

It has been demonstrated that improved met cultivation will enable one and does enable man planters now to grow cotton at a fair profit in infested areas. If the weevil can force cotton p throughout the cotton belt to adopt more civili modern methods of cultivation we may be forced upon the weevil as a "blessing in disguise."

It is impossible better to present the desirabil certainty of results from the cultivation methods mended by the Division of Entomology, States Department of Agriculture, than to qu recommendations given by W. D. Hunter, the agent in charge of the cotton boll weevil investig

"1. Plant early. If possible plant seed of rieties known to mature early, or at least obta from as far north as possible. It is much better the risk of replanting, which is not an expensi ration, than to have the crop delayed. The pra some planters of making two plantings to avoid all the work of chopping thrown into a short p a very bad policy from the weevil standpoint.

Under identical conditions early cotton if im varieties has invariably yielded from two to thre as much as native cotton under the same con and in many cases much more. Planted at the sa the early varieties begin to bloom from twelve t een days sooner than native cotton.

Early planted fields of either native or impro rieties have almost invariably yielded twice as m late planted ones.

The early varieties in general, having a smal and a short tap root, are adapted only for rich soi also fail to grow well in the very light sandy lo many of the river valleys of Texas which, in lo sons before the advent of the boll-weevil, often pr the largest yields. In these situations early v

will yield but little more than native cotton.

2. Cultivate the fields thoroughly. The principal benefit in this comes from the influence that such a practice has upon the constant growth and consequent early maturity of the crop. Very few weevils are killed by cultivation. Much of the benefit of early planting is lost unless it is followed by thorough cultivation. In case of unavoidably delayed planting, the best course for the planter to pursue is to cultivate the fields in the most thorough manner possible. Three choppings and five plowings constitute as thorough a system of cultivation as is necessary in cases where the land has previously been kept reasonably clear.

3. Plant the rows as far apart as experience with the land indicates is feasible, and thin out the plants in the rows thoroughly. On land which in normal seasons will produce from 35 to 40 bushels of corn the rows should be 5 feet apart. Even on poor soil it is doubtful if the distance should ever be less than 4 feet.

4. Destroy, by plowing up, windrowing, and burning, all the cotton stalks in the fields as soon as the weevils become so numerous that practically all the fruit is being punctured. This will generally not be later than the first week in October. Merely cutting off the stalks by means of the triangular implement used for that purpose throughout the south is by no means as effective as plowing, because the stumps remaining give rise to sprouts which furnish food until late in the season to many weevils that would otherwise starve. The plowing, moreover, serves to place the ground in better condition for early planting the following spring. In some cases turning cattle into the fields is advisable. Aside from amounting to a practical destruction of the plants, grazing of the cotton fields furnishes considerable forage at a time when it is generally much in demand. Nevertheless, cattle should never be turned into cotton fields in which Johnson grass has become started.

5. It is known that at present fertilizers are not used to any considerable extent in cotton producing in Texas. There is, nevertheless, no doubt that they should be; not that the land is poor, but that earlier

crops may be procured. At present it is sufficient t
attention to the fact that it has been the uniforn
perience of experiment stations and planters in
eastern part of the belt that certain fertilizers, esp
ly those involving a large percentage of phosphoric
have a strong tendency towards hastening the mat
of the plants."

BIBLIOGRAPHY.

Mally, F. W.
1901. The Mexican Cotton-boll Weevil. Farn
Bulletin, U. S. Dept. Agr. 130: 30 pp. fig. 1-4.

Hunter, W. D.
1903. Methods of Controlling the Boll Weevil
vice based on the work of 1902). Farmers' B
tin, U. S. Dept. Agr. 163: 16 pp. fig. 1-2.

Sanderson, E. D.
1903. The Mexican Boll-Weevil. Texas Exp. S
Ent. Dept. Circ. 1: 8 pp. 4 figures.

Sanderson, E. D.
1903. How to Combat the Mexicon Cotton-boll
vil in Summer and Fall. Texas Exp. Stat.
Dept. Circ. 4: 4 pp.

Morgan, H. A.
1903. The Mexican Cotton-boll Weevil. La.
Station, Circ. 1: 10 pp. fig. 1-3. 1 map.

Cook, O. F.
1904. Report on the habits of the kelep, or Guat
an cotton boll weevil ant. Bull. Bureau Enton
S. Dept. Agr. 49: 15 pp.

Herrick, G. W.
1904. The Mexican Cotton boll weevil. Miss.
Stat. Circ. 17: 7 pp. 2 figures.

Hunter, W. D.
1904. Information Concerning the Mexican C
Boll Weevil. Farmers' Bulletin, U. S. Dept.
189: 31 pp. 8 figs.

Hunter, W. D.
1904. The Status of the Mexican Cotton Boll W
in the United States in 1903. Yearbook, U
Dept. Agr. 1903: 205-214. pl. 17-21.

Hunter, W. D., and Hinds, W. E.
1904. The Mexican Cotton Boll Weevil. Bull.
Entom., U. S. Dept. Agr. 45: 116 pp. 16 pl. 6 fi

BULLETINS

OF

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AUBURN.

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1905.

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ALABAMA

[A]gricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

Tests of Varieties of Cotton

IN 1904

BY

J. F. DUGCAR
Director and Agriculturist.

Opelika, Ala.:
The Post Publishing Company.
1905.

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The Bulletins of this Station will be sent free to any c the State on application to the Agricultural Experiment Auburn, Alabama.

VARIETY TESTS OF COTTON IN 1904.

BY J. F. DUGGAR.

e season of 1904 presented some trying conditions for cotton plant. The rainfall for March was below nor- April was exceedingly dry and the drought was not en until late in May. The total rainfall for March was inches; for April 1.02 inches; and for the first four s in May, less than .75 of an inch. These conditions ted in stands by no means as uniform as is desirable in rimental work.*

e wet weather of July and the heavy rains of the part of August resulted in a vigorous growth of the n plant and a promise of a large crop. From the latter of August until the date of the first light frost there practically no rain. At Auburn the rainfall for Sep- er was only .26 of an inch; for October .02, and for mber 2.28 inches.

e extreme of wet weather in August, followed by very weather in September, resulted in the shedding of an ually large proportion of forms. The shedding of forms lifferent varieties, and under different conditions, has the subject of a co-operative investigation both at Au- and in Montgomery county begun jointly in 1904 this station and the Division of Vegetable Pathol- al and Physiological Investigations of the United States artment of Agriculture. Of course a repetition of that

---

he writer desires to express here his grateful appreciation of valuable assistance in these experiments afforded by Dr. J. T. erson, who furnished the rainfall record; Mr. C. M. Floyd, who charge of the field work at Auburn; Mr. C. H. Billingsley, of United States Department of Agriculture, who furnished the for indicating the relative earliness of varieties, and to Mr. C. udson, who is responsible for most of the calculations.

experiment for several seasons will be needed before conclusive data for publication can be expected.

A light frost occurred late in October and the first killing frost occurred November 14, the latter killing a number of small bolls.

Yields of Varieties in Plots at Auburn.

The field on which these tests were made is known as the ten-acre field. It has a reddish loam soil with a considerable proportion of flinty stones. It is regarded as upland of somewhat better than average quality because of the occasional growing of a crop of cow peas for hay. Every fifth plot throughout most of the field was planted with the Culpepper variety to ascertain if there were any decided inequalities in the fertility of the land.

The land was plowed broadcast with a two-horse plow late in March, and bedded and fertilized just before planting, which occurred April 20th.

The fertilizer per acre consisted of:

64 lbs. nitrate of soda.
120 lbs. cotton seed meal.
240 lbs. acid phosphate.
64 lbs. muriate of potash.

———

488 lbs., total per acre.

For three or four weeks after planting only an occasional seed sprouted, the ground being loose and very dry. Then a roller was run over the field to press the seed into closer contact with the soil, and this was immediately followed by the weeder, a light form of harrow, used to check evaporation. Within a week, and as a result of this rolling and harrowing, a fairly good stand of cotton was in sight, although the weather continued very dry. The plants were so thinned that they averaged, on the plots with perfect stands 18 1-2 inches apart with rows 3 1-2 feet wide. Only one variety, Gold Standard, had such a poor stand as to seri-

ously affect its yield and to necessitate its exclusion from the following table. A careful study of the detailed records led to the conclusion that the yields were not materially affected by the slight deficiencies in stand, though it is possible that the varieties Doughty, with 76 per cent. of a stand, Texas Burr, with 84 per cent., and Truitt, with 86 per cent., might have stood a few points higher if the stand had been perfect. It was concluded that any effort to calculate the probable yields with perfect stands, would, in this case, involve a greater error than is incurred in giving the actual yields without this correction for slight deficiencies in stand.

The following table gives the actual yield of seed cotton, lint, and seed, all these weights being taken at the gin house a number of weeks after the two heaviest pickings had been made, thus permitting all varieties to dry out to a somewhat uniform degree. In the same table are two columns giving the value of the total product of seed and lint per acre, based, in one column, on a price of ten cents per pound for lint, and in the other column on a price of seven cents per pound, the seed in both columns being valued at seventy cents per 100 pounds. These may be called high and low prices. Readers who prefer other prices can substitute their own figures and make their own calculations.

*Yields of lint and seed of 38 varieties of cotton on ...
Farm at Auburn in 1904 and value of the crop per ...*

Rank in value of product	VARIETY.	Stand of plants	Actual yield per acre of: Seed cotton	Actual yield per acre of: Lint	Actual yield per acre of: Seed	Value of seed and lint per acre ...
		%	*Lbs.*	*Lbs.*	*Lbs.*	$
1	Peterkin	100	1624	628	993	$69.
2	Layton Improved	92	1632	620	1011	69.
3	Jackson	100	1584	607	974	67.
4	Alex. Allen	92	1673	581	1088	65.
5	Wise	94	1481	556	905	61.
6	Cameron Early	100	1558	546	1009	61.
7	Simms Long Staple	100	1675	539	1065	61.
8	Pullnot	97	1542	543	963	61.
9	Cook Improved	100	1403	548	852	60.
10	Doughty Improved	76	1336	522	997	59.
11	Allen Long Staple	94	1610	498	1120	5[illegible]
12	Culpepper	96	1486	508	965	57.
13	Texas Burr	84	1488	502	980	57.
14	Willett Red Leaf	95	1352	503	840	56.
15	Hawkins	100	1332	487	839	54.
16	King	100	1396	484	861	54.
17	(Lewis) Prize	92	1297	486	804	54.
18	Russell	100	1431	473	952	53.
19	Nancy Hanks	98	1401	474	916	53.
20	Drake	100	1412	467	942	53.
21	Mascot	100	1292	476	811	53.
22	Shine	94	1368	465	895	52.
22	Sam Woodfin Prolific	97	1400	463	924	52.
23	Jones Improved	100	1392	462	927	52.
24	Truitt	86	1348	462	872	52.
25	Schley	100	1324	457	862	51.
26	Grier's King	96	1248	459	774	51.
27	Edgeworth	100	1288	453	829	51.
28	Garrard	89	1225	453	765	50.
29	Johnson's Excelsior	100	1230	442	785	49.
30	Pride of Georgia	100	1276	436	839	49.
31	Meredith	92	1288	434	846	49.
32	Mortgage Lifter	100	1288	433	841	49.
33	Floradora	100	1296	420	875	48.
34	Parker	100	1196	408	785	46.
35	Blue Ribbon (fuzzy seed)	100	1225	401	813	45.
36	Sunflower	100	1228	401	812	45.
37	Blue Ribbon (black seed) ..	100	1203	379	818	43.
38	Lealand	95	1144	378	765	43.

*Seed 70 cents per 100 lbs. or $14.00 per ton.

The largest yield was made by Peterkin, closely followed by Layton, Jackson and Alex. Allen. Wise occupies fifth place.

Grouping together such of the varieties as the writer has up to this time definitely classified in accordance with the classification outlined by him in Bulletin No. 107 of the Alabama Experiment Station, and neglecting groups of varieties having few representatives in this test, we have average results that are significant, as below:

Average yields of Classes of varieties at Auburn in 19

	Lint per acre	Seed per acre	Value per acre at 10c and $14.00
		Lbs.	
Semi-Cluster Group			
Hawkins	487	839	$54.54
Drake	467	942	53.29
Woodfin	463	924	52.76
Garrard	453	765	50.65
Average	468	867	$52.81
Peterkin Type.			
Peterkin	628	993	$69.75
Layton	620	1011	69.0[illegible]
Wise	556	905	61.93
Average	601	936	$66.91
King Type.			
King	484	861	$54.42
Mascot	477	811	53.27
Shine	465	895	52.76
Grier's King	459	774	51.31
Average	471	835	$52.94
Big Boll Type.			
Culpepper	508	965	$57.56
Texas Burr	502	980	57.06
Russell	473	952	53.96
Jones Improved	462	927	52.68
Truitt	462	872	52.30
Schley	457	862	51.73
Pride of Georgia	436	839	49.47
Mortgage Lifter	433	841	49.18
Average	466	905	$54.79
Long Staple Group.			
Floradora	420	875	$48.12
Sunflower	401	812	45.78
Blue Ribbon (fuzzy seed)	401	813	45.79
Blue Ribbon (black seed)	379	818	43.62
Average	400	829	$46.08

From the above table it will be seen that the Peterkin and varieties having similar qualities were decidedly in the lead at Auburn in 1904 in the production of lint. Taking the yield of lint made by the Peterkin group as 100, we find that the average relative yield of the semi-cluster group may be represented by 78; of the King type by 78; of the big boll group by 77; and of the long staple group by 66. This throws some light on the question of the difference in productiveness on upland soils of the long staple varieties as compared with the other groups. The varieties Allen long staple and Simms long staple are not included in this average for the reason that they grew on the lowest, and doubtless the richest, plots in the field.

The local markets usually pay little or no premium for the long staple varieties, which, however, command a premium of several cents a pound in the larger southern seaport markets. This year at Auburn for the four long staple varieties to have nearly equaled the Peterkin group in value per acre it would have been necessary for long staple lint to sell for 15 cents per pound when Peterkin was 10 cents, or for 10 1-2 cents when Peterkin was worth 7 cents. If we compare the long staple with either of the other groups a much smaller premium would equalize the values. Long staple cotton should have rich bottom land for its best development.

While the Peterkin group is ahead this year, it by no means follows that it will maintain its lead when seasonal conditions and soils are different.

Per Cent. of Lint in Varieties Tested in Plots at Auburn in 1904.

During a study of cotton varieties extending over a number of years a large amount of data have been obtained regarding the proportions of seed and lint of 175 or more varieties which have recently been grown. The following table gives only so much of this data as was obtained in 1904,

by ginning the cotton on these plots of which the yi
reported in the first table of this bulletin.

Per cent of lint in plot tests at Auburn in 1904

	Variety	*Per Cent Lint*	*Variety.*
1	Cook Improved	39.1	Parker ....
2	Gold Standard	38.9	Doughty ....
3	Peterkin	38.7	Pride of Georgia ....
4	Jackson	38.3	Shine ....
5	Wise	37.6	Nancy Hanks ....
6	Prize	37.4	Meredith ....
7	Willett Red Leaf	37.2	Texas Burr ....
8	Garrard	37.0	Mortgage Lifter ....
9	Grier's King	36.8	Jones Improved ....
10	Mascot	36.8	Sunflower ....
11	Hawkins	36.5	Drake ....
12	Johnson's Excelsior ..	36.0	Russell ....
13	King	35.9	Lealand ....
14	Alex. Allen	35.3	Sam Woodfin Prolific ..
15	Edgeworth	35.2	Blue Ribbon (fuzzy see
16	Pullnot	35.2	Floradora ....
17	Cameron Early	35.0	Simms Long Staple ....
18	Schley	34.6	Blue Ribbon (black see
19	Culpepper	34.3	Allen Long Staple .....
20	Truitt	34.3	

It will be noted that the proportion of lint to unusually high. This was also the case in the variet at the Georgia station in 1904, as indicated in a recen paper article by Director R. J. Redding. This conc of results suggests that something in the climatic con of 1904 was favorable to the increase of lint or to the decrease of seed.

It will be noted that the long staple varieties hav lower percentages of lint than most of the short stapl ties.

Variety Tests on Prairie Soil in Montgomery Cou 1904.

Through co-operation with the United States Depa of Agriculture as before stated, we are this year enal

print the results of a variety test made on the A. H. Clarke plantation about half a mile northeast of the depot at McGehee's Switch station, Montgomery county.

The soil is gray prairie upland of about average quality, not recently fertilized, so far as is known, until the present year. Planting was done April 29-30. On June 1, fertilizers as below were applied on the side of the row in the shallow furrow made by the first cultivation. The fertilizer was then covered by the throwing out of the middles. The fertilizer used consisted of:

200 lbs. acid phosphate per acre.
200 lbs. kainit per acre.
100 lbs. nitrate soda per acre.

This date of application was doubtless too late for good results for this season and on this soil, as shown not only in variety tests, but in fertilizer tests on another part of the same field. Through a misunderstanding the plots were not thinned to a uniform stand, but it was found that the yield of three plots of Truitt did not vary greatly with variations in the stand. As it was impracticable to gin the seed cotton of each plot separately at McGehee's, the yield of lint is obtained by multiplying the weight of seed cotton by the per cent. of lint found in the variety test at Auburn in 1904.

Yields of varieties of cotton at McGehee's Switch, Ala., in **1904.**

Plot No.	Rank in value of products	Variety.	No. of plants per acre.	Yield per acre. Seed cotton.	Lint	Seed.	*Value of seed and lint per acre, 10c for lint.	*Value of seed and lint per acre, 7c for lint.
				Lbs.	*Lbs*	*Lbs.*	$	$
18	1	Schley	7070	830	287	543	32.50	23.89
14	2	Peterkin	6390	750	290	460	32.22	23.52
22	3	Drake	6500	690	228	360	31.23	24.39
23	4	Crossland	5750	770	277	493	31.15	22.84
17	5	Toole	6410	790	270	520	30.72	22.62
1	6	King	5630	730	262	468	29.47	21.61
21	7	Bancroft Herlong	6800	800	256	544	29.41	21.73
Av. 5, 10 and 15	8	Truitt	5947	746	256	492	29.03	21.35
20	9	Simms	7630	750	241	509	27.66	20.43
16	10	Floradora	6100	720	233	487	26.70	19.71
11	11	Hawkins	5910	620	226	394	25.35	18.57
2	12	Russell	5670	650	215	435	24.54	18.09
12	13	Cook Long Staple	5830	680	207	473	24.05	17.84
19	14	Doughty Long Staple	6910	600	204	396	23.17	17.05
7	15	Jackson	5800	540	207	333	23.03	17.82
4	16	Parker	6000	560	190	370	21.59	15.89
3	17	Sunflower	6360	560	185	375	21.12	15.57
6	18	Pride of Georgia	5520	530	180	350	20.45	15.05
8	19	Mortgage Lifter	5000	500	167	333	19.03	14.02
13	20	Allen Long Staple	6040	500	154	346	17.82	13.20

*Seed valued at 70 cents per 100 pounds or $14.00 per ton.

The varieties affording the largest value of seed and lint were Schley and Peterkin, closely followed by Drake and Crossland. Toole stands fifth. In this test, as at Auburn, the varieties of the Peterkin type, namely, Peterkin and Crossland stand well to the front with an average yield of 283 1-2 pounds of lint per acre. Taking this yield of lint as 100 per cent., the groups of varieties hitherto classified average as follows:

Peterkin group (Peterkin and Crossland) .... 100.

Big boll group (Russell, Schley, Truitt, Pride of Georgia, and Mortgage Lifter) .... 78.

Relative Earliness of Varieties.

The invasion of the cotton states by the cotton boll weevil renders more important than ever before careful studies of the early varieties. It has been found that only the earliest varieties can be profitably grown in infested regions, even when all other known methods of combatting the weevil are employed.

The rapid spread of the weevil eastward in Louisiana during the past season makes it important that the farmers of Alabama should be ready for this invasion as promptly as possible. It would be well for every neighborhood, and perhaps for every farm, to have at least a small portion of its crop in one of the very early varieties so that seed of early varieties may be everywhere available when urgently needed.

It is easy to determine at a glance that one variety is early and another late, but it is less easy to indicate the relative earliness of intermediate varieties. In the two tables which follow the figures show how many bolls had opened on a given date early in September out of every 100 bolls maturing during the entire season.

These figures are based on counts of bolls on five selected plants of each variety made by Mr. C. H. Billingsley, of the United States Department of Agriculture.

Relative earliness of varieties at Auburn in 1904, as shown by per cent of bolls open on September 1 on counted plants.

Variety.	Per cent bolls open Sept. 1
King	82
Mascot	77
Meredith	49
Garrard	47
Grier's King	46
Lealand	44
Nancy Hanks	44
Shine	42
Jackson	41
Hawkins	35
Layton	34
Johnson Excelsior	33
Edgeworth	32
Texas Burr	32
Pride of Georgia	31
Cameron Early	31
Cook Improved	30
Drake	25
Wise	22
Prize	21
Jones Improved	20
Schley	19
Sunflower	19
Gold Standard	19
Parker	18
Blue Ribbon (wooly seed)	17
Alex. Allen	16
Woodfin	16
Culpepper	15
Blue Ribbon (black seed)	15
Peterkin	15
Doughty	14
Russell	14
Pullnot	14
Floradora	14
Mortgage Lifter	13
Simms Long Staple	13
Allen Long Staple	12
Truitt	10
Cook Long Staple	7
Willett Red Leaf	6

Relative earliness of varieties at McGehee's as shown by per cent of bolls open on September 7, 1904.

Variety.	Per cent bolls open Sept. 7
Toole	81
King	66
Simms	39
Mortgage Lifter	33
Allen Long Staple	32
Sunflower	27
Jackson	27
Parker	25
Russell	25
Schley	24
Truitt	23
Crossland	23
Pride of Georgia	23
Cook Long Staple	18
Peterkin	17
Floradora	15
Doughty	14
Hawkins	13
Drake	12
Bancroft	7

e above tables are based on careful counts made on plants of each variety. Since individual peculiarities me of these plants have greatly affected the positions e table, it is in place to say that judging only by the al appearance of the plots the varieties matured more y together than indicated by the table and at Auburn ollowing varieties especially appeared earlier than is ated by their positions in the tables: Alex. Allen, lfin, and Culpepper.

WHERE TO GET SEED.

e experiment station is unable to supply seed of any ese varieties. In order to enable farmers to obtain of such of these varieties as they desire, addresses are below of parties from whom our seed were obtained 04:

lpepper from J. E. Culpepper, Luthersville, Ga.
ake from R. W. Drake, Laneville, Ala.
ok Improved from J. R. Cook, Schley, Ga.
geworth from J. C. Little, Louisville, Ga.
ue Ribbon from S. C. Experiment Station, Clemson Col- S. C.
ld Standard from Excelsior Seed Farm, Bennettsville,

m Woodfin Prolific from S. V. Woodfin, Marion, Ala.
rker, Sunflower, Russell, Mortgage Lifter, King and son from Unitel States Department of Agriculture, hington, D. C.
uitt and Peterkin from Harvey Seed Co., Montgomery,

mms, Allen Long Staple, Willett Red Leaf, Doughty Staple, Cook Long Staple, Floradora, Hawkins, Jones oved and Schley from N. L. Willett Drug Co., Augusta,

ide of Georgia, Cameron Early, Layton Improved, Mere- Nancy Hanks, Garrard, Grier's King, Mascot, Shine,

Texas Burr, Prize, Wise, Alex. Allen, and Pullnot f
Georgia Experiment Station, Experiment, Ga.

Lealand from H. P. Jones, Herndon, Ga.

Johnson Excelsior from C. R. Baird & Co., Chat
Tenn.

OTHER EXPERIMENTS IN PROGRESS WITH VARIETIES OF

This bulletin relates to only about half of the grown on the experiment station farm at Auburn The space available was not sufficient for the re varieties to be grown on areas large enough to affo rate determinations of the yields.

The remaining varieties, grown on very small a well as the varieties here reported, constitute part periment, the main object of which is to obtain descriptions and photographs of every variety ob east of the boll weevil region. It will require another year before results can be published; meant experiment will be continued in 1905, and for use experiment the writer will be glad to obtain by m growers or originators small packages of seed of established variety which each is growing. The sen requested to exercise care in fully labeling the pa the outside, giving the name and postoffice of the se the true establishel name of the variety.

Our thanks are hereby extended to all of those wh past few years have furnished small lots of seed experiment. I would repeat here the statement have made every spring in the circular letters sent ers. *From the nature of the experiment no repor made by letter as to how any variety stands.* Ho is the intention to send to each contributor of see of the bulletin that will be published when the inve is completed.

BULLETIN NO. 131. FEBRUARY, 1905.

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

Co-operative Fertilizer Experiments With Cotton

IN 1901, 1902, 1903, AND 1904.

By

J. F. DUGGAR,
Director and Agriculturist.

Opelika, Ala.:
The Post Publishing Company.
1905.

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N. C. REW .... Assistant in Animal I

C. M. FLOYD............................ Superintendent c

I. S. McADORY...................Assistant in Veterinary

C. F. KINMAN........................... Assistant in Horti

The Bulletins of this Station will be sent free to any ci the State on application to the Agricultural Experiment Auburn, Alabama.

CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON IN 1901, 1902, 1903, AND 1904.

BY J. F. DUGGAR.

A brief summary of the average results of these experiments may be found on page 67.

For a number of years this station has conducted numerous local fertilizer experiments, furnishing material and instructions to farmers agreeing to make the tests.

The number of local fertilizer experiments with cotton, of which reports were received, was as follows: In 1901, ten; in 1902, thirteen; in 1903, ten, and in 1904, twenty-one. This does not include a number of experiments that were made, but of which the experimenters made no reports or reported accidental loss of results. In all of these years fertilizer experiments were also made on corn and other crops, the results of which will be published in future years.

The chief object of these local fertilizer experiments or soil tests has been to ascertain the best fertilizer or combination of fertilizers for cotton, growing on each of the principal soils of Alabama.

Small lots of carefully weighed and mixed fertilizers were supplied to each experimenter. Detailed instructions as to how to conduct the experiments and blank forms for reporting results, were also furnished.

The following list gives the name and address of ea
perimenter who has reported the results of fertilizer e
ments made under our direction during the last four
with page of this bulletin where the results may be f

COUNTY.	POST OFFICE.	NAME.	DATE.	
Barbour	Louisville	J. D. Veal	1904	
Bibb	Vick	W. T. Chism	1901, '2, '3	
Blount	Tidmore	Jno. W. Staab	1901	
Bullock	Union Sp'gs	N. Gachet	1904	
Butler	Garland	G. L. McLure	1901	
Butler	Greenville	D. H. Rouse	1901	
Butler	Georgiana	J. C. Lee	1904	
Chambers	Fredonia	E. W. Smartt	1904	
Chilton	Clanton	W. A. Chandler	1904	
Choctaw	Naheola	W. G. Bevill	1901, '02	
Coffee	Enterprise	C. A. Hatcher	1904	
Conecuh	Evergreen	J. W. Stewart	1902	
Coosa	Hanover	J. M. Logan	1902, '03	50,
Cullman	Cullman	L. A. Fealy	1903	
Dale	Midland City	W. H. Simmons	1904	
DeKalb	Collinsville	W. F. Fulton	1902, '3	
Elmore	Wetumpka	5th Dist. Agr. School	1901, '2, '3	44,
Elmore	Tallassee	J. D. Billingsley	1903	
Fayette	Newtonville	G. W. Gravlee	1904	
Franklin	Russellville	G. R Pass	1904	
Geneva	Geneva	M. P. Metcalf	1901, '2, '3, '4	
Hale	Greensboro	T. K. Jones	1902, '4	
Lauderdale	Florence	W. A. Parish	1904	
Lawrence	Town Creek	A. A. Owens	1904	
Lee	Auburn	Ala. Expt. Sta.	1902, '4	
Limestone	Athens	P. G. Williams	1903	
Macon	Notasulga	J. P. Slaton	1904	
Madison	Huntsville	C. Davis	1901	
Madison	Huntsville	H. D. N. Wales	1902, '3, '4	
Marion	Hamilton	6th Dist. Agr. School	1903	
Perry	Long	L. Long	1902	
Pickens	Gordo	J. W. French	1901	
Pickens	Gordo	D. W. Davis	1902	
Shelby	Montevallo	J. W. Wyatt	1904	
Talladega	Silver Run	C. L. Jenkins	1902, '3, '4	
Tallapoosa	Camp Hill	Lyman Ward	1902	
Tuscaloosa	Tuscaloosa	E. J. Daffin	1901	
Washington	Carson	R. D. Palmer	1904	

The directions sent required each plot to be one-eighth of an acre in area. Rows were 3 1-2 feet apart, and each experimenter was advised to so thin the cotton as to leave the same number of plants on each plot, preferable at distances of 18 inches between plants.

The directions stated that land employed for this test should be level and uniform, not manured in recent years, and not new ground, or subject to overflow, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity of treatment for all plots (except as to kinds of fertilizers used) was emphasized.

Fertilizers were applied in the usual manner—that is, drilled.

THE RAINFALL.

The following data are taken from the records of the Alabama section of the Weather Bureau and show the average rainfall for the State:

	INCHES RAINFALL.				
	1901	1902	1903	1904	
January	5.32	3.86	3.56	4.17	......
February	4.13	6.52	10.95	3.80	......
March	6.30	8.76	5.91	3.69	......
April	5.27	2.34	2.72	2.22	......
May	5.08	2.34	6.05	2.98	......
June	2.80	1.28	4.88	2.94	......
July	3.40	2.50	3.98	4.80	......
August	8.86	3.48	3.57	5.55	......
September	4.19	4.28	1.41	1.36	......
October	1.04	3.58	1.82	0.34	......
November	1.85	4.22	2.12	2.98	......
December	7.80	5.77	2.93	4.38	......
Average	55.97	49.09	50.22	39.21	......
Average yearly normal	....	....	....	....	51

In the summer of 1902 occurred a drought of unprecedented duration. This was general and in many localities there was little or no rain from April to August. Hence results of that year should be given less weight than those for the other years. In 1904 there was a deficiency of rain in spring and an injurious drought beginning about the middle of August.

The Fertilizers Used.

The following prices are used, as representing approximately the average cash price in local markets during the last few years:

	Per Ton.
Acid phosphate (14 per cent. available).	$14.00
Cotton seed meal	22.00
Kainit	15.00

Prices naturally vary in different localities. Any one can substitute the cost of fertilizers in his locality for the price given above.

In each experiment two plots were left unfertilized, these being plots 3 and 8. The following table shows what kinds and amounts of fertilizers were used on certain plots; the number of pounds of nitrogen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos;

Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.

Plot No.	FERTILIZERS. Amount per acre.	FERTILIZERS. KIND.	MIXTURE CONTAINS Nitrogen.	MIXTURE CONTAINS †Available phosphoric acid.	MIXTURE CONTAINS Potash.	COST OF FERTILIZERS Per ton.	COST OF FERTILIZERS Per acre.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*		
1	200	Cotton seed meal	13.58	5.76	3.54	$22.00	$2.20
		*In 100 lbs. c. s meal.**	**6.79**	**2.88**	**1.77**		
2	240	Acid phosphate	.....	36.12	.....	14.00	1.68
		In 100 lbs. acid phos.	......	**15.05**	.....		
4	200	Kainit		.....	24.60	15.00	1.50
		In 100 lbs. kainit.	......	......	**12.30**		
5	200	Cotton seed meal ...	13.58	41.88	3.54	17.63	3.88
	240	Acid phosphate					
		In 100 lbs. above mixt.	**3.09**	**9.52**	**.80**		
6	200	Cotton seed meal ...	13.58	5.76	28.14	17.50	3.70
	200	Kainit					
		In 100 lbs. above mixt.	**3.39**	**1.44**	**7.03**		
7	240	Acid phosphate				14.45	3.18
	200	Kainit	.....	......	.....		
		In 100 lbs. above mixt.	...	**8.21**	**5.59**		
9	200	Cotton seed meal ...	13.58	41.88	28.14	16.81	5.38
	240	Acid phosphate					
	200	Kainit					
		In 100 lbs. above mixt.	**2.12**	**6.54**	**4.39**		
10	200	Cotton seed meal ...	13.58	41.88	15.84	17.15	4.63
	240	Acid phosphate					
	100	Kainit					
		In 100 lbs. above mixt.	**2.59**	**7.75**	**2.93**		

*Average of many analysis.
†Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by $1\frac{3}{14}$.

In determining the increase over the unfertilized the yield of the fertilized plots, Nos. 4, 5, 6 and 7, i pared with both unfertilized plots, lying on either si ing to each unfertilized plot a weight inversely propo to its distance from the plot under comparison. method of comparison tends to compensate for var in the fertility of the several plots.

PRICE ASSUMED FOR SEED COTTON.

The price assumed is 8 cents per pound for lint and per ton for seed. Deduct from this the cost of picki ginning, ½ cent per pound of seed cotton, and we ha cents as the *net* value per pound of increase of seed this last figure is used in all calculations of profits bulletin.

Huntsville experiments with cotton.

Plot No.	FERTILIZER. Amount pre acre.	FERTILIZER. KIND.	HUNTSVILLE (Davis) 1901 Yield of seed cotton per acre.	HUNTSVILLE (Davis) 1901 Increase over unfertilized plots.	HUNTSVILLE (Wales) 1902 Yield of seed cotton per acre.	HUNTSVILLE (Wales) 1902 Increase over unfertilized plots.	HUNTSVILLE (Wales) 1903 Yield of seed cotton per acre.	HUNTSVILLE (Wales) 1903 Increase over unfertilized plots.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	332	—96	416	56	640	216
2	240	Acid phosphate	524	96	384	24	712	288
3	00	No fertilizer	428		360		424	
4	200	Kainit	512	78	353	00	600	192
5	200 240	Cotton seed meal Acid phosphate	592	154	384	37	712	320
6	200 200	Cotton seed meal Kainit	420	—22	408	67	656	280
7	240 200	Acid phosphate Kainit	616	169	368	33	552	192
8	00	No fertilizer	452		328		344	
9	200 240 200	Cotton seed meal Acid phosphate Kainit	792	340	416	88	648	304
10	200 240 100	Cotton seed meal Acid phosphate Kainit	880	428	448	120	594	250

PERIMENT MADE IN 1901 BY CLARENDON DAVIS, HUNTSVILLE.

d upland soil and subsoil, characteristic of the Tennessee valley.

This field had been in cultivation for many years. The eceding crop was wheat, itself preceded by cowpeas. Ex-sive shedding of forms, due to continued heavy rains in gust, and the occurrence of light but damaging frost ptember 18th, reduced the yield on all plots, but more the plots fertilized heavily and on those receiving cotton d meal. The early frost and the residual fertilizing ects of the cowpeas probably explain the slight effects of ton seed meal, to which in combination with acid phos-ate, cotton usually responds profitably on this grade of l. For yield of seed cotton see page 24. That table ows that the increase in seed cotton per acre was as fol-vs:

ncrease of seed cotton per acre when cotton seed meal was led:

To unfertilized plot	—96 lbs.
To acid phosphate plot	58 lbs.
To kainit plot	—100 lbs.
To acid phosphate and kainit plot	171 lbs.
Average increase with cotton seed meal	8. lbs.

ncrease of seed cotton per acre when acid phosphate was added:

To unfertilized plot	96 lbs.
To cotton seed meal plot	250 lbs.
To kainit plot	91 lbs.
To cotton seed meal and kainit plot	362 lbs.
Average increase with acid phosphate	199 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	78 lbs
To cotton seed meal plot	74 lbs
To acid phosphate plot	73 lbs
To cotton seed meal and acid phosphate plot	186 lbs
Average increase with kainit	102 lbs

The chief need of cotton on this soil was for acid phate. Although there was no rust, the addition of to the phosphate was profitable. The conditions i test did not give to cotton seed meal a fair opportu show the favorable effects that may usually be expe it on this soil. Yet a complete fertilizer was the profitable, plot 10 leading with a net profit of $6.90 p after paying for fertilizers and for picking and ginni increase, on the basis of lint at 8 cents and cotton see cents per hundred pounds.

Experiments Made in 1902, 1903, and 1904 by H. Wales, Huntsville.

Red clay soil and subsoil.

The excessively long dry period from April to Augu dered all fertilizers ineffective in 1902. For yields a crease of crop see table on page 24. The 1903 expe was preceded by two corn crops in succession. Tha the largest yield resulted from the use of a mixture phosphate and cotton seed meal. Kainit was of little use in combination, but on plot 4 it seemed useful used alone. There was no rust. Mr. Wales think early frost cut off one-half of the expected yields on 9 and 10, and did less injury on other plots.

In 1904 the experiment was on similar soil, tha borne a crop of cowpeas three years before and the been uncultivated for two years. The largest yiel again obtained from plot 5, fertilized with 200 pou

on seed meal and 240 pounds acid phosphate. Mr. les added an eleventh plot fertilized with 200 pounds l phosphate and 100 pounds cotton seed meal, the yield vhich was 684 pounds, or practically as good as plots 9, 10, containing kainit and a larger amount of cotton l meal. Cotton seed meal was highly profitable when ployed in combination, but less useful alone. Kainit generally useless. In view of results recorded in this letin and in those obtained in previous experiments on ical red upland Tennessee valley soil, I would suggest as eneral fertilizer for cotton on that soil

to 120 lbs. cotton seed meal per acre.
to 240 lbs acid phosphate per acre.

to 360 lbs. total per acre.

f the cotton stalks grow very small it might be advisable increase the proportion of cotton seed meal to one-f of the mixture.

ncrease of seed cotton per acre when cotton seed meal was ed:

	1902	1903	1904
unfertilized plot	56 lbs.	216 lbs.	64 lbs.
acid phosphate plot	13 lbs.	32 lbs.	405 lbs.
kainit plot	67 lbs.	88 lbs.	367 lbs.
acid phosphate and kainit plot	55 lbs.	112 lbs.	179 lbs.
erage increase with cotton seed meal	**47 lbs.**	**112 lbs.**	**253 lbs.**

ncrease of seed cotton per acre when acid phosphate was added:

unfertilized plot	24 lbs.	288 lbs.	120 lbs.
cotton sed meal plot	—19 lbs.	104 lbs.	462 lbs.
kainit plot	—33 lbs.	0 lbs.	186 lbs.
cotton seed meal and kainit plot	21 lbs.	24 lbs.	—2 lbs.
erage increase with acid phosphate	**14 lbs.**	**104 lbs.**	**167 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	0 lbs.	192 lbs.	—5 lbs.
To cotton seed meal plot	11 lbs.	64 lbs.	298 lbs.
To acid phosphate plot	9 lbs.	96 lbs.	61 lbs.
To cotton seed meal and phosphate plot	51 lbs.	16 lbs.	—160 lbs.
Average increase with kainit	17 lbs.	92 lbs.	19 lbs.

Experiments Made by C. L. Jenkins, near Silver Run, Talladega County.

Most of the soil on this farm, six miles south of Oxford, is light reddish to yellowish loam, apparently fairly well supplied with lime.

In 1902. The preceding crop was wheat. No cowpeas had been grown in recent years. The early part of the season was very dry. All three fertilizer materials were useful, a complete fertilizer giving the largest yield.

In 1903. The largest yield was obtained by the use of a complete fertilizer consisting of

200 lbs. cotton seed meal per acre.
240 lbs acid phosphate per acre.
100 lbs kainit per acre.

In 1904. Again the largest yield was obtained by the complete formula just mentioned. Plot 5 this year, without kainit, yields almost as much as the plots with complete fertilizers. The first need of this soil seems to be for phosphate but nitrogen and potash were added with effect.

Silver Run experiments with cotton.

Plot No.	FERTILIZER. Amount per acre.	FERTILIZER. KIND.	SILVER RUN 1902 Yield of seed cotton per acre.	SILVER RUN 1902 Increase over unfertilized plots	SILVER RUN 1903 Yield of seed cotton per acre.	SILVER RUN 1903 Increase over unfertilized plots	SILVER RUN 1904 Yield of seed cotton per acre.	SILVER RUN 1904 Increase over unfertilized plots,
	Lbs		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	144	40	200	—80	576	48
2	240	Acid phosphate	184	80	392	112	544	16
3	00	No fertilizer	104		280		528	
4	200	Kainit	240	129	480	187	568	37
5	200 240	Cotton seed meal ... Acid phosphate	324	207	672	366	880	345
6	200 200	Cotton seed meal ... Kainit	356	233	568	249	696	158
7	240 200	Acid phosphate ..... Kainit	304	175	744	412	648	107
8		No fertilizer	136		344		544	
9	200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	492	356	776	432	880	336
10	200 240 100	Cotton seed meal ... Acid phosphate ..... Kainit	455	320	920	576	944	406

Increase of seed cotton when cotton seed meal was added:

	1902	1903	1904
To unfertilized plot	40 lbs.	80 lbs.	48 lbs.
To acid phosphate plot	127 lbs.	254 lbs.	329 lbs.
To kainit plot	104 lbs.	62 lbs.	121 lbs.
To acid phosphate and kainit plot	181 lbs.	20 lbs.	229 lbs.
Average increase with cotton seed meal..	**95 lbs.**	**64 lbs.**	**181 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	80 lbs.	112 lbs.	16 lbs.
To cotton seed meal plot	167 lbs.	446 lbs.	297 lbs.
To kainit plot	46 lbs.	225 lbs.	70 lbs.
To cotton seed meal and kainit plot....	123 lbs.	183 lbs.	178 lbs.
Average increase with acid phosphate..	**106 lbs.**	**242 lbs.**	**140 lbs.**

Increase of seed cotton per acre when kainit was added

To unfertilized plot	129 lbs.	187 lbs.
To cotton seed meal plot	193 lbs.	329 lbs.
To acid phosphate plot	95 lbs.	300 lbs.
To cotton seed meal and acid phos. plot	149 lbs.	66 lbs.
Average increase with kainit	141 lbs.	221 lbs.

EXPERIMENTS MADE BY W. F. FULTON, ONE MILE SO COLLLINSVILLE, DEKALB COUNTY.

Soil reddish or mullatto, subsoil red.

For table showing yields see page 31.

Both in 1902 and in 1903 the largest increase r from the use of cotton seed meal and acid phospl gether. Plainly kainit was not needed. Neither was seed meal alone, nor phosphate alone, sufficient. the fifth fertilizer experiment with cotton that Mr. has made on the red soils of Big Wills Valley, the Larimore and the later tests at Collinsville. Ea the description of the soil is about the same, reddisl soil, underlaid by red clay, and all apparently cal These tests all agree in showing:

(1) That the chief need of cotton on this soil is f phate.

(2) That the addition of cotton seed meal to t phosphate is profitable.

(3) That in the presence of phosphate and mea is useless.

The results suggest that the best fertilizer for th ley soils is one containing more phosphate than r suggest 200 pounds acid phosphate and 100 pound seed meal. Earlier results are recorded in bulletins and 113 of this station. The following analysis sh increase attributed to fertilizers in 1902 and 1903:

In none of the five experiments made by Mr. Fulton was there any injury by rust.

The average increase for the two years was on plot 5, receiving phosphate and meal, 348 pounds, affording a net profit per acre of $5.77 after paying cost of fertilizer and of ginning and picking the increase.

Collinsville and Montevallo experiments.

Plot No.	FERTILIZER. Amount per acre.	FERTILIZER. KIND.	Collinsville 1902 Yield of seed cotton per acre.	Collinsville 1902 Increase over unfertilized plots.	Collinsville 1903 Yield of seed cotton per acre.	Collinsville 1903 Increase over unfertilized plots.	Montevallo 1904 Yield of seed cotton per acre.	Montevallo 1904 Increase over unfertilized plots.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	440	144	376	48	1056	192
2	240	Acid phosphtae	416	120	550	232	1000	146
3	00	No fertilizer	296		328		864	
4	200	Kainit	336	30	336	3	1056	144
5	200 240	Cotton seed meal Acid phosphtae	624	307	728	390	1072	112
6	200 200	Cotton seed meal Kainit			528	185	1208	300
7	240 200	Acid phosphtae Kainit	496	158	616	268	1384	328
8	00	No fertilizer	348		352		1104	
9	200 240 200	Cotton seed meal Acid phosphtae Kainit	544	196	712	360	1568	464
10	200 240 100	Cotton seed meal Acid phosphtae Kainit	512	164	712	360	1560	456

Increase of seed cotton per acre when cotton seed meal was added:

	1902	1903
To unfertilized plot	144 lbs.	48 lbs.
To acid phosphate plot	187 lbs.	158 lbs.
To kainit plot	—	182 lbs.
To acid phosphate and kainit plot	38 lbs.	92 lbs.
Average increase with cotton seed meal	123 lbs.	120 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	120 lbs.	232 lbs.
To cotton seed meal plot	168 lbs.	342 lbs.
To kainit plot	128 lbs.	265 lbs.
To cotton seed meal and kainit plot	—	175 lbs.
Average increase with acid phosphate	137 lbs.	253 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	30 lbs.	3 lbs.
To cotton seed meal plot	—	137 lbs.
To acid phosphate plot	38 lbs.	36 lbs.
To cotton seed meal and acid phosphate plot	—111 lbs.	—31 lbs.
Average increase with kainit	—14 lbs.	36 lbs.

Experiment Made by J. W. Wyatt, Five Miles East of Montevallo, Shelby County.

Dark, reddish, sandy upland with red clay subsoil.

This field had been cleared of its second growth of timber for about fifteen years, and for about ten years in succession had been planted in cotton.

The original growth is reported to have been oak, hickory, chestnut and dogwood, and the second growth springing up when the land was thrown out of cultivation after the civil war was short leaf pine and sumac. No mention is made of rust.

The complete fertilizer raised the yield to more than a bale per acre, an increase of 464 pounds. The complete fertilizer with 100 pounds of kainit was more profitable than the one with a larger amount of kainit, the former affording a profit of $7.23 per acre after paying for fertilizer and picking and ginning of the increase.

rease of seed cotton when cotton seed meal was added:

To unfertilized plot	192 lbs.
To acid phosphate plot	—34 lbs.
To kainit plot	56 lbs.
To acid phosphate and kainit plot	136 lbs.
Average increase with cotton seed meal	**87 lbs.**

rease of seed cotton per acre when acid phosphate was added:

To unfertilized plot	146 lbs.
To cotton seed meal plot	—80 lbs.
To kainit plot	184 lbs.
To cotton seed meal and kainit plot	264 lbs.
Average increase with acid phosphate	**128 lbs.**

rease of seed cotton per acre when kainit was added:

To unfertilized plot	144 lbs.
To cotton seed meal plot	8 lbs.
To acid phosphate plot	182 lbs.
To cotton seed meal and acid phosphate plot	352 lbs.
Average increase with kainit	**171 lbs.**

ERIMENT MADE BY G. R. PASS, RUSSELLVILLE, FRANKLIN COUNTY.

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test was made on dark reddish clay upland with clay subsoil.

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e original growth is described as oak and hickory with wild cherry and walnut. Unfortunately for showing ull effects of cotton seed meal, the preceding crop was eas, the entire growth being plowed under in the fall 03. The stand was good.

r yields and increase see table on page 36. The largest and the greatest profit per acre were obtained on plot here only cotton seed meal and acid phosphate were oyed. With this fertilizer the increase was 595 pounds cre and the net profit, after paying for fertilizer and

picking and ginning of increase, was $11.59. Cotton meal was highly profitable in spite of the fact that th ceding pea crop had supplied a large amount of nit Kainit was useless, if not indeed injurious.

Increase of seed cotton when cotton seed meal was added

To unfertilized plot	448 lbs.
To acid phosphate plot	323 lbs.
To kainit plot	163 lbs.
To acid phosphate and kainit plot	142 lbs.
Average increase with cotton seed meal	**244 lbs.**

Increase of seed cotton per acre when acid phosphate was

To unfertilized plot	272 lbs.
To cotton seed meal plot	147 lbs.
To kainit plot	208 lbs.
To cotton seed meal and kainit plot	187 lbs.
Average increase with acid phosphate	**203 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	42 lbs.
To cotton seed meal plot	—243 lbs.
To acid phosphate plot	—22 lbs.
To cotton seed meal and acid phosphate plot	—203 lbs.
Average decrease with kainit	**106 lbs.**

Experiment Made by L. Long, Long P. O., Perry Co in 1902.

Worn red prairie with some sand.

For yields and increase see table on page 36.

This soil had been uncultivated for several years, bu borne two crops of cotton just before the experimen made. With a mixture of cotton seed meal and phos (plot 5) the increase was 360 pounds, affording a net of $5.48 per acre. Acid phosphate seems to have bee fertilizer chiefly needed, and the addition of cotton

meal to the phosphate was highly profitable. Kainit was unprofitable.

These results suggest that a suitable fertilizer for this soil might well contain more phosphate than meal, say two-thirds acid phosphate and one-third cotton seed meal. Mr. Long added an additional plot fertilized only with four 2-horse loads unweighed stable manure per acre. From this the increase over the nearest unfertilized plot was 188 pounds of seed cotton per acre.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	104 lbs.
To acid phosphate plot	64 lbs.
To kainit plot	144 lbs.
To acid phosphate and kainit plot	112 lbs.
Average increase with cotton seed meal	**106 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	296 lbs.
To cotton seed meal plot	256 lbs.
To kainit plot	300 lbs.
To cotton seed meal and kainit plot	268 lbs.
Average increase with acid phosphate	**278 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	4 lbs.
To cotton seed meal plot	44 lbs.
To acid phosphate plot	8 lbs.
To cotton seed meal and acid phosphate plot	56 lbs.
Average increase with kainit	**28 lbs.**

Russellville, Long, Tidmore and Cullman experime

Plot No.	Fertilizer: Amount per acre.	Fertilizer: Kind.	Russellville 1904: Yield of seed cotton per acre.	Russellville 1904: Increase over unfertilized plots.	Long 1902: Yield of seed cotton per acre.	Long 1902: Increase over unfertilized plots.	Tidmore 1901: Yield of seed cotton per acre.	Tidmore 1901: Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs*
1	200	Cotton seed meal	1112	448	296	104	32	32
2	240	Acid phosphate	936	272	488	296	52	232
3	00	No fertilizer	664		192		292	
4	200	Kainit	768	42	192	4	276	4
5	200 240	Cotton seed meal ... Acid phosphate	1384	595	544	36	688	436
6	200 200	Cotton seed meal ... Kainit	1056	205	328	148	488	256
7	240 200	Acid phosphate ..... Kainit	1096	250	480	304	400	188
8	00	No fertilizer	976		172		192	
9	200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	1368	392	588	416	752	560
10	200 240 100	Cotton seed meal ... Acid phosphate ..... Kainit	1424	448	468	296	796	604

EXPERIMENT MADE BY JNO. W. STAAB, TWO MILES, N
OF TIDMORE, BLOUNT COUNTY.

Light, gray, sandy soil with red loam subsoil 4 to 6
below the surface.

This upland field had been in cultivation about
years. The original growth is reported as shortleaf
gum, mountain oak, persimmon, and hickory. All
were thinned to the same number of plants. For yiel
increase see table on page 36. A complete fertilize
taining 100 pounds of kainit gave the largest increas
a net profit of $11.07 per acre. A mixture of cotto
meal and phosphate was also highly profitable.

The conclusions drawn by Mr. Staab from this experi-
ent and from previous experience are here quoted:

"1. That 50 to 100 pounds of fertilizer per acre is not fficient to mature a full crop.

2. That even the heavy applications do not pay unless e ground contains considerable humus.

3. That phosphatic fertilizers in connection with cotton ed meal or cowpeas, or weeds turned under green will pay tter than nine-tenths of the fertilizers commonly used.

4. That heavy applications help crops into quick ger- ination and more rapid growth, lessening expense for eing.

5. That a reduction of acreage and adequate increase of anures are advisable.

6. I do not find kainit of nearly the value it is advertised; times of drought it shows for itself by the wilting of liage. This is ameliorated by a mixture of cotton seed eal and acid phosphate."

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	32 lbs.
To acid phosphate plot	204 lbs.
To kainit plot	252 lbs.
To acid phosphate and kainit plot	372 lbs.
Average increase with cotton seed meal	215 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	232 lbs.
To cotton seed meal plot	404 lbs.
To kainit plot	184 lbs.
To cotton seed meal and kainit plot	304 lbs.
Average increase with acid phosphate	282 lbs.

Increase of seed cotton per acre when kainit was added

To unfertilized plot	4 lb
To cotton seed meal plot	224 lb
To acid phosphate plot	—44 lb
To cotton seed meal and acid phosphate plot	124 lb
Average increase with kainit	**77 lb**

EXPERIMENT MADE AT CULLMAN IN 1904.

This experiment was conducted by Mr. Feirtag fo[r]
A. Fealy. The land is described as very poor and
as entirely fair. The soil is not described but was p
the characteristic sandy soil of that region. For yie
increase see table on page 36. The largest increa
the greatest profit were obtained on plot 5 from a
of acid phosphate and cotton seed meal, the net pro
being $7.43 per acre.

Increase of seed cotton when cotton seed meal was add

To unfertilized plot	104 l
To acid phosphate plot	291 l
To kainit plot	259 l
To acid phosphate and kainit plot	66 l
Average increase with cotton seed meal	**180**

Increase of seed cotton per acre when acid phosphate wa

To unfertilized plot	144
To cotton seed meal plot	331
To kainit plot	212
To cotton seed meal and kainit plot	19
Average increase with acid phosphate	**176**

Increase of seed cotton per acre when kainit was adde

To unfertilized plot	82
To cotton seed meal plot	237
To acid phosphate plot	150
To cotton seed meal and acid phosphate plot	—75 lb
Average increase with kainit	**98**

EXPERIMENT MADE BY J. W. FRENCH, 3½ MILES NORTH OF GORDO, PICKENS COUNTY, IN 1901.

Gray, sandy upland with yellow clay subsoil.

The original growth is reported as shortleaf pine and sweet gum, which had been removed about twenty years before. On this soil cotton sometimes rusts, but there was no rust on plots fertilized with kainit in 1901. The season was dry.

Gordo, Tuscaloosa, and Hamilton experiments.

Plot No.	FERTILIZER. Amount per acre	FERTILIZER. KIND.	GORDO 1901 Yield of seed cotton per acre.	GORDO 1901 Increase over unfertilized plots.	GORDO 1902 Yield of seed cotton per acre.	GORDO 1902 Increase over unfertilized plots.	TUSCALOOSA 1901 Yield of seed cotton per acre.	TUSCALOOSA 1901 Increase over unfertilized plots.	HAMILTON 1903 Yield of seed cotton per acre.	HAMILTON 1903 Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	512	144	656	120	552	104	745	155
2	240	Acid phosphate	448	80	680	144	592	144	780	190
3	00	No fertilizer	368		536		448		590	
4	200	Kainit	432	87	536	00	416	39	600	10
5	200 240	Cotton seed meal ... Acid phosphate	568	459	808	272	812	351	870	280
6	200 200	Cotton seed meal ... Kainit	592	272	640	104	792	532	840	250
7	240 200	Acid phosphate ..... Kainit	536	91	800	64	696	223	810	220
8	00	No fertilizer	256		536		480			
9	200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	616	360	896	360	960	480	980	390
10	200 240 100	Cotton seed meal ... Acid phosphate ..... Kainit	608	352	848	312	792	231	870	280

A complete fertilizer gave the best yield. In a complete fertilizer 100 pounds of kainit was sufficient, plot 10 affording a net profit of $4.52.

Increase of seed cotton per acre when cotton seed meal added:

To unfertilized plot ....144 lbs.
To acid phosphate plot ....165 lbs.
To kainit plot ....185 lbs.
To acid phosphate and kainit plot .... 69 lbs.

Average increase with cotton seed meal........181 lbs.

Increase of seed cotton per acre when acid phosphate was ad-

To unfertilized plot .... 80 lbs.
To cotton seed meal plot ....101 lbs.
To kainit plot ....204 lbs.
To cotton seed meal and kainit plot .... 88 lbs.

Average increase with acid phosphate ....118 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .... 87 lbs.
To cotton seed meal plot ....121 lbs.
To acid phosphate plot ....211 lbs.
To cotton seed meal and acid phosphate plot ..115 lbs.

Average increase with kainit ....133 lbs.

EXPERIMENT MADE BY D. W. DAVIS, 1½ MILES NORTHEAS GORDO, PICKENS COUNTY, IN 1902.

Snuff colored, sandy clay loam with dark reddish subsoil.

This upland field had been in cultivation for many ye the two preceding crops being corn with a scant growt cowpeas between the rows. The original growth was oak, black jack oak, hickory and pine. The stand was form. For yield and increase see table on page 39.

A complete fertilizer gave the largest yield and a profit on plot 9 of $3.96 per acre. While all three fertili were beneficial, the chief need was for phosphate. Pre ing crops of cowpeas obscured the results from cotton

meal. Kainit, though useful, was less needed than it was the preceding year on the apparently lighter soil of Mr. French's farm.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	120 lbs.
To acid phosphate plot	128 lbs.
To kainit plot	104 lbs.
To acid phosphate and kainit plot	96 lbs.
Average increase with cotton seed meal	**112 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	144 lbs.
To cotton seed meal plot	152 lbs.
To kainit plot	264 lbs.
To cotton seed meal and kainit plot	256 lbs.
Average increase with acid phosphate	**204 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	00 lbs.
To cotton seed meal plot	—16 lbs.
To acid phosphate plot	120 lbs.
To cotton seed meal and acid phosphate plot	88 lbs.
Average increase with kainit	**64 lbs.**

Experiment Conducted by E. J. Daffin, 3½ Miles South of Tuscaloosa, in 1901.

Gray, sandy soil, with yellow subsoil.

This field had been cleared about sixty years. The original growth is reported as oak, hickory, shortleaf pine, sweet gum, elm, mulberry, poplar and beech.

Black rust was severe on all plots. The season was dry until August, when excessive rains occurred.. The stands were very thin, but uniform on each plot.

The largest yield was made with the complete fertilizer. Six hundred and forty pounds of a complete fertilizer on

plot 9 increased the yield 480 pounds of seed cotton
ing (at 8 cents for lint) a net profit of $7.10 per ac
paying for fertilizers and cost of ginning and pick
increase. Cotton seed meal was important, and ph
equally so; kainit was useful, but less needed than t
two, and was effective only when combined with
both of the others.

The results of the 1901 test are in accord with
experiments made by Mr. Daffin in 1900 on the san
(property of Hon. F. S. Moody) and with those obta
him in 1897 and 1898 on the county Poor-house farn

Increase of seed cotton per acre when cotton seed meal wa

To unfertilized plot ....104 l
To acid phosphate plot ....207 l
To kainit plot ....292 l
To acid phosphate and kainit plot ....257 l

Average increase with cotton seed meal.......215 l

Increase of seed cotton per acre when acid phosphate wa

To unfertilized plot ....144 l
To cotton seed meal plot ....247 l
To kainit plot ....262 l
To cotton seed meal and kainit plot ....227 l
Average increase with acid phosphate ....220 l

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ....—39 l
To cotton seed meal plot ....149 l
To acid phosphate plot .... 79 l
To cotton seed meal and acid phosphate plot ..129 l

Average increase with kainit .... 79 l

We may safely conclude that on soils of this ch
near Tuscaloosa cotton requires a large proportion
phate, considerable cotton seed meal, and less of
than of either meal or phosphate.

For yields and increase see table on page 39.

Experiment Conducted by the Sixth District Agricultural School at Hamilton, Marion County, in 1903.

Soil dark loam with light red subsoil.

This upland soil had been cleared many years, then thrown out of cultivation, and again taken into cultivation five years before the test began.

On plots 7, 9 and 10 the stand was imperfect. The largest yield was made with the complete fertilizer, but potash was less needful than either cotton seed meal or phosphate.

The largest net profit, on plot 9, was $3.46.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	155 lbs.
To acid phosphate plot	90 lbs.
To kainit plot	240 lbs.
To acid phosphate and kainit plot	170 lbs.
Average increase with cotton seed meal	**163 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	190 lbs.
To cotton seed meal plot	125 lbs.
To kainit plot	210 lbs.
To cotton seed meal and kainit plot	140 lbs.
Average increase with acid phosphate	**166 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	10 lbs.
To cotton seed meal plot	95 lbs.
To acid phosphate plot	30 lbs.
To cotton seed meal and acid phosphate plot	110 lbs.
Average increase with kainit	**61 lbs.**

Experiment Made by Fifth District Agricultural School, Wetumpka, in 1901.

Dark gray loam soil with reddish subsoil.

This upland field is reported as having been cleared about twenty years before of its growth of longleaf pines and small water oaks.

For the three years preceding the experiment it was uncultivated and grew up in grass and briers.

There was little or no black rust. The stand was uniform.

The average results indicate that the chief need was for phosphate. Neither kainit nor cotton seed meal was of much use the first year after the plowing in of large amounts of vegetable matter,. The need for phosphate is also suggested by the results of the 1903 inconclusive experiment on the same farm. See pages 47 and 71.

The largest net profit was from plot 5, $4.65.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	64 lbs.
To acid phosphate plot	116 lbs.
To kainit plot	63 lbs.
To acid phosphate and kainit plot	—93 lbs.
Average increase with cotton seed meal	37 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	170 lbs.
To cotton seed meal plot	222 lbs.
To kainit plot	234 lbs.
To cotton seed meal and kainit plot	78 lbs.
Average increase with acid phosphate	176 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	67 lbs.
To cotton seed meal plot	66 lbs.
To acid phosphate plot	131 lbs.
To cotton seed meal and acid phosphate plot	—78 lbs.
Average increase with kainit	**46 lbs.**

Experiment Made by J. D. Billingsley, Five Miles West of Tallassee, in Elmore County, in 1903.

Black sandy upland; light colored subsoil.

The original growth of longleaf pine and oak had been removed about thirty years before. There was no rust and very little shedding. All plots were thinned to the same number of plants, namely, 5,760 per acre.

The rainfall was favorable. For yields see page 47.

The largest yield was obtained from the complete fertilizer which afforded an increase of 552 pounds of seed cotton per acre, or a net profit on plot 6 of $8.97, and on plot 10 of $9.67. The principal need was for potash and nitrogen, this being one of the few soils where, in the absence of rust, kainit was more important than acid phosphate.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	136 lbs.
To acid phosphate plot	204 lbs.
To kainit plot	470 lbs.
To acid phosphate and kainit plot	225 lbs.
Average increase with cotton seed meal	**258 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	40 lbs.
To cotton seed meal plot	108 lbs.
To kainit plot	301 lbs.
To cotton seed meal and kainit plot	56 lbs.
Average increase with acid phosphate	**126 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	26 lbs.
To cotton seed meal plot	360 lbs.
To acid phosphate plot	287 lbs.
To cotton seed meal and acid phosphate plot	308 lbs.
Average increase with kainit	**245 lbs.**

Experiment Made by J. P. Slaton, Seven Miles South of Notasulga.

This test was made on gray sandy hillside with stiffer reddish subsoil.

The original growth was longleaf pine, oak, hickory and gum, cleared eight years before. For two years preceding the experiment the land was pastured. Unfortunately the land was not plowed until May 17th, which delay reduced the yields. The stand was good on all plots. For yields and increase see table on page 47.

The complete fertilizer was most profitable, plot 9 giving an increase of 544 pounds of seed cotton per acre, equivalent to a net profit of $8.76 per acre.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	256 lbs.
To acid phosphate plot	105 lbs.
To kainit plot	173 lbs.
To acid phosphate and kainit plot	210 lbs.
Average increase with cotton seed meal	**186 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	276 lbs.
To cotton seed meal plot	129 lbs.
To kainit plot	128 lbs.
To cotton seed meal and kainit plot	165 lbs.
Average increase with acid phosphate	**174 lbs**

crease of seed cotton per acre when kainit was added:

To unfertilized plot ....206 lbs.
To cotton seed meal plot ....123 lbs.
To acid phosphate plot .... 58 lbs.
To cotton seed meal and acid phosphate plot..163 lbs.

Average increase with kainit ....137 lbs.

'umpka, Tallassee, Notasulga and Auburn fertilizer experiments.

FERTILIZER.		WETUMPKA 1901		TALLASSEE 1903		NOTASULGA 1904		AUBURN 1902	
Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
.bs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
200	Cotton seed meal	424	64	480	136	528	256	594	178
240	Acid phosphate	536	170	384	40	548	276	477	63
00	No fertilizer	360		344		272		416	
200	Kainit	432	67	376	26	472	206	629	201
200 240	Cotton seed meal ... Acid phosphate	656	286	600	244	640	381	580	140
200 200	Cotton seed meal ... Kainit	504	130	832	469	632	379	662	211
240 200	Acid phosphate ..... Kainit	680	301	696	327	580	334	648	185
00	No fertilizer	384		376		240		475	
200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	592	208	928	552	784	544	741	266
200 240 100	Cotton seed meal ... Acid phosphate ...... Kainit	664	280	926	550	564	324	729	254

EXPERIMENT ON STATION FARM AT AUBURN, IN 1902.

Light, sandy soil with porous sandy subsoil.

'his test was made on the poorest hilltop on the station

farm where no leguminous crop had grown for a nu
of years. The absence of any considerable rain bet
April and August ruined the yield.

The stand was uniform on all plots. The chief nee
this sand bank this excessively dry year was for kainit,
the largest yield was from complete fertilizer.

EXPERIMENT CONDUCTED BY W. T. CHISM, IN 1901, 1902
1903, AT VICK, BIBB COUNTY.

Grayish, sandy, second bottom with yellow subsoi

This land has been long in cultivation. On adja
similar land the forest growth consists of shortleaf
white and red oaks, gum, cucumber tree, dogwood, hic
and beech. For yields and increase see table on pag

In 1901. All plots were reduced to the same numbe
plants, 6,400 per acre. The two preceding crops had
cotton. The largest increase, 388 pounds of seed co
per acre, or a net profit of $5.31 per acre, was obta
where a complete fertilizer was used. This year nitr
was apparently the plant food chiefly needed, but both
phoric acid and potash were advantageous. There
practically no rust on any plot.

In 1902. Dry weather, almost continuous from Apri
August, made the yields on all plots low and all fertil
practically useless.

In 1903. The two preceding crops had been cotton.
spring was late and cold. No rust occurred. As in
cotton seed meal greatly increased the yield while phosp
and kainit were less important, but advantageous. Plo
afforded the largest increase, 446 pounds, or a net prof
$6.19 per acre.

The results suggest that the phosphate in the com
fertilizer might have been much reduced without injur
the crop.

Mr. Chism also made similar experiments in 1899 and 1900. In those years cotton seed meal was the only fertilizer that was of material advantage. The results as a whole indicate that on this second bottom a fertilizer of unusual composition is required and that it should contain more of cotton seed meal than of any other fertilizer.

Experiments at Vick, Bibb county.

Plot No.	FERTILIZER. Amount per acre.	FERTILIZER. Kind.	Vick 1901 Yield of seed cotton per acre.	Vick 1901 Increase over unfertilized plots	Vick 1902 Yield of seed cotton per acre.	Vick 1902 Increase over unfertilized plots	Vick 1903 Yield of seed cotton per acre.	Vick 1903 Increase over unfertilized plots
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	676	122	352	48	864	242
2	240	Acid phosphate	612	128	360	56	572	—50
3	00	No fertilizer	484		304		622	
4	200	Kainit	636	156	364	57	700	75
5	200 240	Cotton seed meal ... Acid phosphate	732	256	412	102	970	348
6	200 200	Cotton seed meal ... Kainit	740	268	400	86	940	310
7	240 200	Acid phosphate ..... Kainit	716	248	432	115	752	119
8	00	No fertilizer	464		320		636	
9	200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	852	388	432	112	1024	388
10	200 240 100	Cotton seed meal ... Acid phosphate ..... Kainit	728	264	428	108	1052	416

Increase of seed cotton per acre when cotton seed meal was added:

	1901	1903
To unfertilized plot	192 lbs.	242 lbs.
To acid phosphate plot	128 lbs.	398 lbs.
To kainit plot	112 lbs.	235 lbs.
To acid phosphate and kainit plot	140 lbs.	262 lbs.
Average increase with cotton seed meal	**143 lbs.**	**284 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	128 lbs.	50 lbs.
To cotton seed meal plot	64 lbs.	106 lbs.
To kainit plot	92 lbs.	44 lbs.
To cotton seed meal and kainit plot	120 lbs.	84 lbs.
Average increase with acid phosphate	101 lbs.	46 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	156 lbs.	75 lbs.
To cotton seed meal plot	76 lbs.	68 lbs.
To acid phosphate plot	120 lbs.	189 lbs.
To cotton seed meal and acid phosphate plot	132 lbs.	40 lbs.
Average increase with kainit	121 lbs.	88 lbs.

Experiment Made by the Southern Industrial Institute, Camp Hill, Tallapoosa County, in 1902.

Gray, sandy soil, with sandy subsoil.

A protracted drought made all fertilizers practically useless, the average increase from cotton seed meal being only 18 pounds, from phosphate 31 pounds, and from kainit 17 pounds. The most favorable result, on plot 7, entailed a loss on account of fertilizers of 94 cents per acre.

Experiments Made 2½ Miles South of Hanover, Coosa County, by J. M. Logan, in 1902.

Dark gray sandy soil with some rock; yellowish subsoil.

The original growth, removed about 40 years before, consisted of longleaf pine, hickory and oak. Recent crops have all been cotton. The largest increase, 392 pounds of seed cotton per acre, was obtained from the use of a complete fertilizer, affording a net profit of $5.56 per acre. Phosphate used alone or with kainit, was of little value, but combined with both it was highly advantageous.

Camp Hill, Hanover, Florence and Athens experiments.

Plot No.	Fertilizer: Amount per acre.	Fertilizer: Kind.	Camp Hill 1902: Yield of seed cotton per acre.	Camp Hill 1902: Increase over unfertilized plots.	Hanover 1903: Yield of seed cotton per acre.	Hanover 1903: Increase over unfertilized plots.	Florence 1904: Yield of seed cotton per acre.	Florence 1904: Increase over unfertilized plots.	Athens 1904: Yield of seed cotton per acre.	Athens 1904: Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	576	32	360	120	732	284	560	208
2	240	Acid phosphate	536	—8	264	24	1144	696	600	248
3	00	No fertilizer	544		240		448		352	
4	200	Kainit	528	—15	376	137	784	334	656	295
5	200 240	Cotton seed meal Acid phosphate	584	43	352	116	1416	965	728	357
6	200 200	Cotton seed meal Kainit	656	27	368	132	1024	571	760	379
7	240 200	Acid phosphate Kainit	624	86	384	151	1272	828	592	201
8	00	No fertilizer	536		232		456		400	
9	200 240 200	Cotton seed meal Acid phosphate Kainit	576	40	536	304	1492	1036	816	416
10	200 240 100	Cotton seed meal Acid phosphate Kainit	536	00	624	392	1200	744	872	472

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .... 120 lbs.
To acid phosphate plot .... 92 lbs.
To kainit plot .... 4 lbs.
To acid phosphate and kainit plot .... 153 lbs.

Average increase with cotton seed meal .... 90 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .... 24 lbs.
To cotton seed meal plot .... —4 lbs.
To kainit plot .... 11 lbs.
To cotton seed meal and kainit plot .... 171 lbs.

Average increase with acid phosphate .... 50 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	136 lbs.
To cotton seed meal plot	13 lbs.
To acid phosphate plot	127 lbs.
To cotton seed meal and acid phosphate plot	188 lbs.
Average increase with kainit	113 lbs.

Experiment Made by W. A. Parish, Ten Miles West of Florence, Lauderdale County.

Light, gray soil with pale reddish subsoil.

This field had been cleared 40 or 50 years. The original growth is reported as postoak and black jack oak.

The experimenter reports that there was no black rust, but that "red rust" was present, but did little damage. The season was dry. The stand was good and uniform.

The complete fertilizer more than trebled the yield of the unfertilized plots, raising the yield to about a bale per acre. This is an increase of 1,036 pounds of seed cotton, equal to a net profit of $21.56 per acre after paying for fertilizer and picking and ginning of increase. Every fertilizer, whether applied singly, by twos, or all three together, profitably increased the yield. The fertilizer most needed was phosphate. The one least needed was kainit which, however, was profitable.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	284 lbs.
To acid phosphate plot	269 lbs.
To kainit plot	237 lbs.
To acid phosphate and kainit plot	208 lbs.
Average increase with cotton seed meal	249 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	696 lbs.
To cotton seed meal plot	681 lbs.
To kainit plot	494 lbs.
To cotton seed meal and kainit plot	465 lbs.
Average increase with acid phosphate	584 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	334 lbs.
To cotton seed meal plot	287 lbs.
To acid phosphate plot	132 lbs.
To cotton seed meal and acid phosphate plot..	71 lbs.
Average increase with kainit	212 lbs.

Experiment Made by P. G. Williams, 1½ Miles West of Athens, Limestone County.

Dark brown loam or clay with red subsoil.

This field had been cleared many years. The original growth is reported as oak, black jack oak, gum and popuar.

There was no rust, but drought and early frost cut short the yield. The most profitable fertilizer was the complete one containing 100 pounds of kainit. With this the increase was 472 pounds of seed cotton per acre, thus affording a net profit above the cost of fertilizer and picking and ginning of increase of $7.64 per acre. However, all fertilizers whether applied singly, by twos, or by threes, profitably increased the yield.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	208 lbs.
To acid phosphate plot	109 lbs.
To kainit plot	84 lbs.
To acid phosphate and kainit plot	215 lbs.
Average increase with cotton seed meal	154 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ....284 lbs.
To cotton seed meal plot ....149 lbs.
To kainit plot ....—94 lbs.
To cotton seed meal and kainit plot .... 37 lbs.

Average increase with acid phosphate .... 85 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ....295 lbs.
To cotton seed meal plot ....171 lbs.
To acid phosphate plot ....—47 lbs.
To cotton seed meal and acid phosphate plot.. 59 lbs.

Average increase with kainit ....119 lbs.

Experiments by W. G. Bevill, Naheola, Choctaw County, in 1901 and 1902.

"Mulatto" upland with clay subsoil.

The land had been long in cultivation. The original growth was reported as both long and shortleaf pine. The immediately preceding crops were cotton.

For yields see table on page ——

Rust was worst on plot 5, but there was little of it on the kainit plots. Dry weather from June to August, followed by a violent storm, greatly reduced the yield. The stand was good.

In 1901. The largest increase, 448 pounds of seed cotton per acre, was from a complete fertilizer. However, in a complete fertilizer, 100 pounds of kainit was sufficient; plot 9 afforded a net profit of $8.13 per acre.

In 1902. In spite of the drought from April till August, cotton seed meal and acid phosphate profitably increased the yield. Plot 5 afforded an increase of 247 pounds, or a net profit of $2.54, or a few cents less than plot 10 and a few cents less than plot 9.

Naheola, Greenville, and Evergreen experiments.

FERTILIZER. Amount per acre.	FERTILIZER. KIND.	NAHEOLA 1901 Yield of seed cotton per acre.	NAHEOLA 1901 Increase over unfertilized plots.	NAHEOLA 1902 Yield of seed cotton per acre.	NAHEOLA 1902 Increase over unfertilized plots.	GR'EN-VILLE 1901 Yield of seed cotton per acre.	GR'EN-VILLE 1901 Increase over unfertilized plots.	EVERGREEN 1902 Yield of seed cotton per acre.	EVERGREEN 1902 Increase over unfertilized plots.
Lbs		*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*
200	Cotton seed meal	648	120	400	-32	632	304	384	80
240	Acid phosphate	664	136	504	72	616	288	384	80
00	No fertilizer	528		432		328		304	
200	Kainit	664	130	296	-141	352	24	224	-64
200 240	Cotton seed meal ... Acid phosphate	760	220	688	247	696	268	672	400
200 200	Cotton seed meal ... Kainit	856	310	616	170	664	326	696	440
240 200	Acid phosphate ..... Kainit	696	143	600	149	528	200	688	448
00	No fertilizer	560		456				224	
200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	1008	418	744	288	632	304	800	592
200 240 100	Cotton seed meal ... Acid phosphate ..... Kainit	1000	440	744	288	784	456	768	576

Increase of seed cotton per acre when cotton seed meal was added:

	1901	1902
o unfertilized plot	120 lbs.	—32 lbs.
o acid phosphate plot	84 lbs.	175 lbs.
o kainit plot	180 lbs.	311 lbs.
o acid phosphate and kainit plot	305 lbs.	139 lbs.
verage increase with cotton seed meal..........	**172 lbs.**	**145 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

	1901	1902
o unfertilized plot	136 lbs.	72 lbs.
o cotton seed meal plot	100 lbs.	279 lbs.
o kainit plot	13 lbs.	290 lbs.
o cotton seed meal and kainit plot	138 lbs.	118 lbs.
verage increase with acid phosphate	**96 lbs.**	**189 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	130 lbs.	—141 lbs.
To cotton seed meal plot	190 lbs.	202 lbs.
To acid phosphate plot	7 lbs.	75 lbs.
To cotton seed meal and acid phosphate plot	228 lbs.	41 lbs.
Average increase with kainit	138 lbs.	44 lbs.

EXPERIMENT BY D. H. ROUSE, GREENVILLE, IN 1901.

Worn, red land.

The average increase is the greatest with cotton seed meal, 172 pounds of seed cotton per acre, and next with acid phosphate. Kainit was ineffective. This test is not entirely conclusive.

For table of yields see page 55.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	304 lbs.
To acid phosphate plot	—20 lbs.
To kainit plot	302 lbs.
To acid phosphate and kainit plot	104 lbs.
Average increase with cotton seed meal	172 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	288 lbs.
To cotton seed meal plot	—36 lbs.
To kainit plot	176 lbs.
To cotton seed meal and kainit plot	—22 lbs.
Average increase with acid phosphate	101 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	24 lbs.
To cotton seed meal plot	22 lbs.
To acid phosphate plot	—88 lbs.
To cotton seed meal and acid phosphate plot	36 lbs.
Average decrease with kainit	1 lbs.

EXPERIMENT BY J. W. STUART, AT EVERGREEN, IN 1902.

Gray sandy upland with reddish subsoil.

For yields see page 55.

There was no rust. The stand was uniform. In spite of the severe drought every combination of fertilizers effected a highly profitable increase in the crop. However, when used separately, no fertilizer material exerted its full effect.

The largest increase, 592 pounds of seed cotton per acre, resulted from the use of a complete fertilizer, but in the complete fertilizer 100 pounds of kainit was nearly as effective as a larger amount. Plot 10 afforded a net profit of $10.34 per acre after paying for fertilizer and for picking and ginning the increase.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	80 lbs.
To acid phosphate plot	320 lbs.
To kainit plot	504 lbs.
To acid phosphate and kainit plot	144 lbs.
Average increase with cotton seed meal	**264 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	80 lbs.
To cotton seed meal plot	320 lbs.
To kainit plot	512 lbs.
To cotton seed meal and kainit plot	152 lbs.
Average increase with acid phosphate	**266 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—64 lbs.
To cotton seed meal plot	360 lbs.
To acid phosphate plot	368 lbs.
To cotton seed meal and acid phosphate plot	192 lbs.
Average increase with kainit	**214 lbs.**

Experiment Conducted by J. D. Veal, Three Miles N of Louisville, Barbour County.

Gray, sandy soil, with stiffer gray subsoil.

This upland field had been cleared of its growth o and hickory and longleaf pine about thirty years b For the two years preceding this experiment corn grown on this land, but whether cowpeas were grow tween the corn rows was not stated.

The stand on all plots was good. A complete fer afforded the largest increase in yield, 474 pounds of cotton per acre, a net profit of $6.94 per acre. The plete fertilizer with 200 pounds of kainit was a little profitable than the one containing 100 pounds of k This is a case in which the increased yield from kaini not due to its influence on rust, for Mr. Veal reports there was no rust on any plot. See table page 66.

The combination of acid phosphate and cotton seed was highly profitable, but less so than the complete izers.

Increase of seed cotton per acre when cotton seed meal was a

To unfertiized plot	48 lbs.
To acid phosphate plot	253 lbs.
To kainit plot	301 lbs.
To acid phosphate and kainit plot	242 lbs.
Average increase with cotton seed meal	**211 lbs.**

Increase of seed cotton per acre when acid phosphate was a

To unfertilized plot	120 lbs.
To cotton seed meal plot	325 lbs.
To kainit plot	268 lbs.
To cotton seed meal and kainit plot	209 lbs.
Average increase with acid phosphate	**230 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	—34 lbs.
To cotton seed meal plot	219 lbs.
To acid phosphate plot	114 lbs.
To cotton seed meal and acid phosphate plot	103 lbs.
Average increase with kainit	100 lbs.

Experiment Made by C. A. Hatcher, Two Miles Southeast of Enterprise, Coffee County.

Gray, sandy loam, with stiff gray subsoil.

The longleaf pines had been cut on this field about 18 years before. There were 7,360 plants per acre on all plots. For yields and increase see table on page 60. The crop preceding the experiment was corn with cowpeas in the drill and peanuts between the corn rows. It is not stated whether the peanuts were consumed as usual by hogs on the land, or removed.

In spite of these preceding leguminous crops and of the fact that the corn had been fertilized with eight bushels of cotton seed per acre, the application of cotton seed meal to cotton was decidedly profitable. The material most needed was acid phosphate. The greatest increase in yield, 616 pounds of seed cotton worth $16.01 net, resulted from the use of 640 pounds of a complete fertilizer, and this complete fertilizer afforded a net profit of $10.63 per acre.

Kainit was distinctly advantageous and profitable whenever combined with acid phosphate. The complete fertilizer combining 200 pounds of kainit was more profitable than the one with 100 pounds.

No mention is made of rust.

Louisville, Enterprise, Georgiana, and Garland experim

Plot No.	FERTILIZER. Amount per acre.	FERTILIZER. KIND.	LOUISVILLE 1904 Yield of seed cotton per acre.	LOUISVILLE 1904 Increase over unfertilized plots.	ENTERPRISE 1904 Yield of seed cotton per acre.	ENTERPRISE 1904 Increase over unfertilized plots.	GEORGIANA 1904 Yield of seed cotton per acre.	GEORGIANA 1904 Increase over unfertilized plots.
	Lbs		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	240	48	552	272	976	64
2	240	Acid phosphate	312	120	536	256	1112	200
3	00	No fertilizer	192		286		912	
4	200	Kainit	184	—34	304	24	976	70
5	200 240	Cotton seed meal ... Acid phosphate	616	373	680	400	1264	364
6	200 200	Kainit .... Cotton seed meal ..	536	267	528	248	1184	291
7	240 200	Acid phosphate ..... Kainit	528	234	768	488	1096	210
8	00	No fertilizer	320		280		880	
9	200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	796	476	896	616	264	384
10	200 240 100	Cotton seed meal ... Acid phosphate ..... Kainit	724	404	800	520	240	360

Increase of seed cotton per acre when cotton seed meal was

To unfertilized plot ....272 lb

To acid phosphate plot ....144 lb

To kainit plot ....224 lb

To acid phosphate and kainit plot ....128 lb

Average increase with cotton seed meal ......192 lb

Increase of seed cotton per acre when acid phosphate was

To unfertilized plot ....256 lb

To cotton seed meal plot ....128 lb

To kainit plot ....464 lb

To cotton seed meal and kainit plot ....368 lb

Average increase with acid phosphate ....304 lb

Incre:.se of seed cotton per acre when kainit was added:

To unfertilized plot	24 lbs.
To cotton seed meal plot	—24 lbs.
To acid phosphate plot	232 lbs.
To cotton seed meal and acid phosphate plot	216 lbs.
Average increase with kainit	**112 lbs.**

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xPERIMENTS MADE BY J. C. LEE, 1904, 1 1-4 MILES NORTH OF GEORGIANA.

Gray "pineywoods" upland with red clay subsoil.

The land had been cleared about ten years. The original rowth was longleaf pine with some oak, hickory, and dog-ood.

There had been no cowpeas on this land in recent years.

There was no rust, but shedding was severe. The stand as good and uniform. For yields see page 60. The iost profitable increase, 364 pounds of seed cotton per acre, esulted from the use of cotton seed meal and acid phos-hate. This mixture gave a net profit of $5.58 per acre. 'he addition of kainit to this mixture was not notably help-ul. The chief need of this soil was for phosphate and not
ı!. The chief need of this soil was for phosphate and next

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	64 lbs.
To acid phosphate plot	164 lbs.
To kainit plot	221 lbs.
To acid phosphate and kainit plot	174 lbs.
Average increase with cotton seed meal	**155 lbs.**

Increase of seed cotton per acre when acid phosphate was

To unfertilized plot	200 lbs
To cotton seed meal plot	300 lbs
To kainit plot	140 lbs
To cotton seed meal and kainit plot	193. lbs
Average increase with acid phosphate	**208 lbs**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	70 lbs.
To cotton seed meal plot	227 lbs.
To acid phosphate plot	10 lbs.
To cotton seed meal and acid phosphate plot	20 lbs.
Average increase with kainit	**81 lbs.**

EXPERIMENT MADE IN 1901, BY G. L. MCLURE. TWO EAST OF GARLAND, BUTLER COUNTY.

This gray upland pine soil had been cleared abou years. The original growth was longleaf pine and jack oak. The preceding crop was oats. Acid phos was highly profitable and cotton seed meal effective. I was effective only when combined with the other two. largest increase, 560 pounds of seed cotton per acre obtained from the use of a complete fertilizer. Th plot 9, gave a net profit of $9.46 per acre. For yie table on page 60.

Two experiments previously made by Mr. McLur two made near by at Lumber Mills, accord with the r here recorded in showing that the pineywoods soils o region are highly responsive to a mixture of acid phos and cotton seed meal, and that kainit is highly ben only when rust is severe.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	296 lbs.
To acid phosphate plot	—2 lbs.
To kainit plot	86 lbs.
To acid phosphate and kainit plot	123 lbs.
Average increase with cotton seed meal	**125 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	448 lbs.
To cotton seed meal plot	150 lbs.
To kainit plot	386 lbs.
To cotton seed meal and kainit plot	423 lbs.
Average increase with acid phosphate	**351 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	51 lbs.
To cotton seed meal plot	—159 lbs.
To acid phosphate plot	—11 lbs.
To cotton seed meal and acid phosphate plot	114 lbs.
Average decrease with kainit	**1 lbs.**

XPERIMENT MADE BY W. H. SIMMONS, MIDLAND CITY, DALE COUNTY.

Alone none of the fertilizers was very advantageous, but a complete fertilizer all three were decidedly beneficial. ne largest increase, 296 pounds of seed cotton per acre, re- lted from the use of the complete fertilizer on plot 9. his afforded a net profit of $2.32 per acre, which is nearly ne cents more than the profit on plot 10, where less kainit as used. See table on page 64.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	88 lbs.
To acid phosphate plot	127 lbs.
To kainit plot	86 lbs.
To acid phosphate and kainit plot	139 lbs.
Average increase with cotton seed meal	**110 lbs.**

Increase of seed cotton per acre when acid phosphate was a

To unfertilized plot .... 56 lbs.
To cotton seed meal plot .... 95 lbs.
To kainit plot ....113 lbs.
To cotton seed meal and kainit plot ....166 lbs.

Average increase with acid phosphate ....107 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .... 44 lbs.
To cotton seed meal plot .... 42 lbs.
To acid phosphate plot ....101 lbs.
To cotton seed meal and acid phosphate plot ..113 lbs.

Average increase with kainit .... 75 lbs.

Midland City and Geneva experiments.

FERTILIZER.			MIDLAND CITY 1904		GENEVA 1901		GENEVA 1902	
Plot No.	Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
	Lb.		*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	312	88	488	112	763	8
2	240	Acid phosphate	280	56	672	295	880	120
3	00	No fertilizer	224		376		768	
4	200	Kainit	264	44	424	48	1088	359
5	200 240	Cotton seed meal ... Acid phosphate	400	183	600	224	1000	323
6	200 200	Cotton seed meal ... Kainit	344	130	448	72	1008	373
7	240 200	Acid phosphate .... Kainit	368	157	608	232	1016	423
8	00	No fertilizer	208		376		552	
9	200 240 200	Cotton seed meal ... Acid phosphate .... Kainit	504	296	640	264	1040	488
10	200 240 100	Cotton seed meal ... Acid phosphate .... Kainit	472	264	600	224	912	360

EXPERIMENTS BY P. M. METCALF, 4½ MILES NORTH OF GENEVA.

Gray or light sandy upland with stiffer red subsoil, eight inches from surface.

For yields see table on pages 64 and 74.

In 1901. This was the fourth crop after clearing, all previous crops being corn with cowpeas and peanuts between. No mention is made of rust.

On this fresh land where leguminous crops had grown for several years, phosphate was the only material of marked value. Phosphate alone increased the yield 296 pounds of seed cotton per acre, affording a net profit of $6.02 per acre, after paying cost of fertilizer and picking and ginning of increase.

In 1902. The immediately preceding crop was oats, which in turn had been preceded by two crops of corn, probably with cowpeas or peanuts between, as is customary in that locality.

The time since clearing is not stated.

Protracted drought and abundance of cotton caterpillars in October reduced the yields. No mention is made of black rust, but Mr. Metcalf writes that "Plots 1, 2, 3, 4 and 8 had much of what we know as red rust." In this unfavorable year kainit was by far the most effective single fertilizer, increasing the yield when used alone 369 pounds. The complete fertilizer containing a full ration of kainit increased the yield 488 pounds of seed cotton, affording a net profit of $6.31 per acre.

Mr. Metcalf writes: "I learn from this experiment that it pays to use lots of guano and of high quality."

In 1903. This was the sixth year since the clearing of this land. The crops in 1902 were oats, followed by Spanish peanuts. There was no rust. This experiment is rendered inconclusive by the wide variation in the yields of

the two unfertilized plots and by the contradictory results on plots 9 and 10, hence it is recorded in the table on page 74.

In 1904. Cotton in this experiment constituted the fourth crop since clearing. The two preceding crops had been corn and peanuts, the peanuts not picked. The summer was dry. The largest increase, 528 pounds of seed cotton per acre, was made by the complete fertilizer, affording a net profit above cost of fertilizer, ginning and picking of $9.38 per acre.

Again the chief need seems to have been for kainit, acid phosphate being almost as important, and cotton seed meal somewhat less important by reason of recent crops of peanuts.

Increase of seed cotton per acre when cotton seed meal was added:

	1901	1902	1904
To unfertilized plot	112 lbs.	8 lbs.	— 8 lbs.
To acid phosphate plot	—72 lbs.	203 lbs.	77 lbs.
To kainit plot	24 lbs.	4 lbs.	182 lbs.
To acid phosphate and kainit plot	32 lbs.	65 lbs.	286 lbs.
Average increase with cotton seed meal	**24 lbs.**	**70 lbs.**	**136 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	296 lbs.	120 lbs.	48 lbs.
To cotton seed meal plot	112 lbs.	315 lbs.	133 lbs.
To kainit plot	184 lbs.	54 lbs.	76 lbs.
To cotton seed meal and kainit plot	192 lbs.	25 lbs.	180 lbs.
Average increase with acid phosphate	**196 lbs.**	**128 lbs.**	**109 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	48 lbs.	369 lbs.	166 lbs.
To cotton seed meal plot	—40 lbs.	365 lbs.	356 lbs.
To acid phosphate plot	—64 lbs.	303 lbs.	194 lbs.
To cotton seed meal and acid phos. plot	40 lbs.	165 lbs.	402 lbs.
Average increase with kainit	**—4 lbs.**	**300 lbs.**	**270 lbs.**

Do Fertilizers Pay?

Let the figures answer. The following table gives the average of all the 41 conclusive experiments recorded in this bulletin. It shows the average increase in seed cotton, due to fertilizers, throughout Alabama and the net profit due to fertilizers, after paying liberal prices for fertilizers, and after paying 50 cents per hundred pounds of seed cotton for picking and ginning the increased yields.

Average increase in 41 experiments in seed cotton per acre and net profit per acre from fertilizers, after deducting cost of fertilizer and cost of picking and ginning the increase.

Plot No.	FERTILIZER. Amount per acre.	FERTILIZER. KIND.	Increase in seed cotton from fertilizers.	Net profit per acre from fertilizers with seed at 60c per 100 lbs. and Lint at 6c.	Lint at 8c.	Lint at 10c.
	Lbs.		*Lbs.*	$	$	$
2	240	Acid phosphate	55	1.26	2.35	3.36
5	200 240	Cotton seed meal Acid phosphate	302	1.85	3.97	5.87
9	200 240 200	Cotton seed meal Acid phosphate Kainit	91	2.04	4.78	7.25
10	200 240 100	Cotton seed meal Acid phosphate Kainit	365	2.30	4.86	7.26

The above table deserves careful study. Even with cotton calculated at six cents per pound, fertilizers were profitable, the average net profit per acre ranging from $1.26 to $2.30.

With eight-cent cotton the average net profits from fertilizers assume important proportions, ranging from $2.35 and $4.86 per acre.

With ten cent cotton the average profits range between $3.36 and $7.26 per acre.

Whether cotton be priced at six, eight, or ten cents per pound, the average profit per acre was greater with a mixture of cotton seed meal and phosphate than with phosphate alone, and still greater when 100 pounds of kainit was added to this mixture, thus making a complete fertilizer.

Conclusions and Suggestions.

These are based on these experiments and on results published in former bulletins of this station.

1. In all soil belts, except perhaps on certain grades of rich prairie soil, where tests have been made with cotton under the direction of this station acid phosphate has been almost universally beneficial.

2. Kainit is less frequently needed than either acid phosphate or cotton seed meal, and a considerable proportion of the soils on which it has been most advantageous lie in the southern part of the State. On soils where cotton is especially liable to "black rust" and in all parts of the State in seasons when that disease is especially injurious, kainit is at its best. On most soils, containing much clay, it can be profitably dispensed with. Where needed, an application of 100 pounds per acre is usually sufficient for cotton.

3. Cotton seed meal is highly beneficial to cotton on a large proportion of the cultivated area of every soil belt in Alabama. Apparently it is universally needed on uplands except on (1) new grounds and (2) on soils containing considerable vegetable matter.

4. On old soils, as a rule, it is more profitable to employ for cotton a mixture of acid phosphate and cotton seed meal or of these two and kainit, than to use an equal money value of any one of them alone.

5. The usual basis for a fertilizer formula for cotton

in regions where commercial fertilizers are generally employed should be acid phosphate, of which 100 to 240 pounds should be used per acre, in addition to cotton seed meal or other nitrogenous fertilizer as necessary.

6. The proper proportion of cotton seed meal to acid phosphate in a fertilizer formula for cotton depends largely on the recent cropping and manuring of the field.

(a) Small stalks, (if not due to climatic influences, poor cultivation, etc.) are usually an indication that nitrogen (as in cotton seed meal), is needed.

(b) Excessive stalk or "weed growth" of cotton is an indication that nitrogen can be dispensed with wholly or partially.

(c) Phosphate hastens maturity.

(d) The fresher the land the less the need for nitrogen.

(e) A luxuriant growth of cowpeas just preceding cotton dispenses with the necessity for cotton seed meal, as does a recent heavy dressing with stable manure or cotton seed.

7. Nitrogen costs about three times as much as phosphoric acid or potash and hence most of it should be produced on the farm by growing soil-improving plants, (as cowpeas, velvet beans, vetch, crimson clover, etc.) and by increasing the number of livestock and the amount of stable manure saved.

8. In response to requests for recommendations of definite fertilizer formulas for cotton on different soils, the writer would tentatively suggest the following to be modified somewhat when the facts mentioned in paragraph 6 seem to require it:

(a) For red lime lands in North Alabama; for the red clay lands occupying a triangular area in the central portion of East Alabama—for the most part north of the Western Railway and east of the Coosa River—and for the stiffer non-calcareous soils of the northwestern and western part of the State:

80 to 120 lbs. cotton seed meal per acre.
160 to 240 .bs. acid phosphate per acre.

240 to 360 lbs. total per acre.

(b) For sandy soils in the eastern and central
the State:

80 to 120 lbs. cotton seed meal per acre.
160 to 240 lbs. acid phosphate per acre.
40 to 60 lbs. kainit per acre.

280 to 420 lbs. total per acre.

(c) For the level lands of the southern Longl
Region:

60 to 120 lbs. cotton seed meal per acre.
120 to 240 lbs. acid phosphate per acre.
60 to 80 lbs. kainit per acre.

240 to 440 lbs. total per acre.

(d) For any well drained soil in any part of t
on which cotton is known to be especially liable
rust:

120 to 160 lbs. cotton seed meal per acre.
80 to 120 lbs. acid phosphate per acre.
80 to 120 lbs. kainit per acre.

280 to 400 lbs. total per acre.

9. The formulas suggested above contain appro
the following percentages of nitrogen (and its large
lent in ammonia), available phosphoric acid, and
using phosphate containing 12 1-2 per cent. of availa
phoric acid. A phosphate of higher grade is advisal

FORMULA.	Per Cent. Nitrogen.........	Per Cent. Ammonia.........	Per Cent. Available Phosphoric Acid.....	Per Cent. Potash.........
(a) For certain red lands	2.3	2.8	9.3	0.6
(b) For certain sandy lands	2.0	2.4	8.0	2.3
(c) For low longleaf pine lands	1.9	2.3	7.6	2.8
(d) For "rusting" soils	3.0	3.6	4.8	4.3

10. On the lime soils of the Central Prairie Region commercial fertilizers are not generally used. Prairie soils are often in poor mechanical condition and need vegetable matter and drainage more than commercial fertilizers. The poorer soils often need both cotton seed meal and phosphate.

INCONCLUSIVE EXPERIMENTS.

These sometimes afford suggestions or hints which may serve to strengthen the conclusions derived from the more positive experiments previously recorded.

At Town Creek, one-quarter of a mile southeast of the town, Mr. A. A. Owens made the test on what he describes as white sandy land with yellowish subsoil. There was no rust, but drought. This experiment was undertaken by Mr. R. R. Reed, who turned the fertilizers over to Mr. Owens. The test is inconclusive for the reason of the tearing of one of the fertilizer sacks, probably that for plot 9.

The Newtonville experiment in Fayette county was made by G. W. Gravlee, but was vitiated by late germination and irregular stands.

The experiment at Hanover, Coosa county, was made by J. M. Logan on gray gravelly or rocky land with red clay subsoil. The results suggest that kainit was not needed.

The test one mile east of Fredonia, Chambers county, was made by E. W. Smart on dark upland with red subsoil. Inequalities in stand, due, he reports, to disease of the young

plants, vitiated the experiment. The results suggest that a mixture of cotton seed meal and acid phosphate was sufficient. Cowpeas in corn or after oats, and grazed, grew on the land in each of two years preceding the experiment.

Mr. W. A. Candler, Clanton, Chilton county, made the experiment on land where the preceding winter he had plowed in a very rank growth of cowpea vines, affording conditions unsuitable for a test of commercial fertilizers.

At Wetumpka, the test was made on the farm of the District Agricultural Schools with conflicting results both in 1902 and 1903.

At Greensboro the tests were made by T. K. Jones, 1 1-2 miles south of town on poor red upland, originally covered with hardwood. In 1902 manure was accidentally added to certain plots, and in 1904 the growth of grass ruined the experiment.

Four miles north of Union Springs Mr. N. Gachet made a test on light, reddish loam with red clay subsoil, where the original growth had been hardwoods. Variations in the stand destroyed the value of the experiment.

The test at Carson, Washington county, was consigned to Mr. R. D. Palmer. It was made on gray upland, pine land with yellow clay subsoil, two miles north of Carson. The results are somewhat conflicting.

For the Geneva experiment, see page 66.

Credit is due Mr. C. R. Hudson for making or checking all calculations in this bulletin.

Town Creek, Newtonville, Hanover, Fredonia, Clanton and Wetumpka experiments.

Plot No.	FERTILIZER. Amount per acre.	FERTILIZER. KIND.	TOWN CREEK 1904 Yield of seed cotton per acre.	TOWN CREEK 1904 Increase over unfertilized plots.	NEWTON-VILLE 1904 Yield of seed cotton per acre.	NEWTON-VILLE 1904 Increase over unfertilized plots.	HANOVER 1902 Yield of seed cotton per acre.	HANOVER 1902 Increase over unfertilized plots.	FREDONIA 1904 Yield of seed cotton per acre.	FREDONIA 1904 Increase over unfertilized plots.	CLANTON 1904 Yield of seed cotton per acre.	CLANTON 1904 Increase over unfertilized plots.	WETUMP-KA 1902 Yield of seed cotton per acre.	WETUMP-KA 1902 Increase over unfertilized plots.	WETUMP-KA 1903 Yield of seed cotton per acre.	WETUMP-KA 1903 Increase over unfertilized plots.
	Lbs.		*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	232	40	123	69	328	152	496	56	1320	—248	648	—64	76	648
2	240	Acid phosphate	248	56	222	168	376	200	656	216	1376	—192	760	48	776	248
3	00	No fertilizer	192	00	54	00	176	00	440	00	1568	00	712	00	00	00
4	200	Kainit	232	44	68	6	248	45	720	216	1696	123	656	14	768	240
5	200 240	Cotton seed meal ... Acid phosphate	348	162	234	164	536	366	899	328	1456	—12	648	19	1040	512
6	200 200	Cotton seed meal ... Kainit	416	233	96	18	360	102	824	192	1472	—110	754	167	816	288
7	240 200	Acid phosphate ..... Kainit	392	213	174	88	320	35	944	248	1472	—115	744	198	560	32
8	00	No fertilizer	176	00	94	00	312	00	760	00	1592	00	504	00	528	00
9	200 240 200	Cotton seed meal ... Acid phosphate...... Kainit	368	192	184	90	296	—16	1008	248	1384	—208	632	128	672	144
10	200 240 100	Cotton seed meal ... Acid phosphate...... Kainit	408	232	247	153	352	40	1048	288	1376	—216	552	48	888	360

Greensboro, Union Springs, Carson and Geneva inconclusive fertilizer experiments.

Plot No.	FERTILIZER. Amount per acre.	FERTILIZER. KIND.	AUBURN 1904 Yield of seed cotton per acre.	AUBURN 1904 Increase over unfertilized plots.	GREENSBORO 1902 Yield of seed cotton per acre.	GREENSBORO 1902 Increase over unfertilized plots.	GREENSBORO 1904 Yield of seed cotton per acre.	GREENSBORO 1904 Increase over unfertilized plots.	UNION SPRINGS 1904 Yield of seed cotton per acre.	UNION SPRINGS 1904 Increase over unfertilized plots.	CARSON 1904 Yield of seed cotton per acre.	CARSON 1904 Increase over unfertilized plots.	GENEVA 1903 Yield of seed cotton per acre.	GENEVA 1903 Increase over unfertilized plots.
	Lbs		*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*	*Lbs*
1	200	Cotton seed meal	928	120	352	96	320	228	00	00	856	112	696	112
2	240	Acid phosphate	1136	40	328	72	164	72	552	72	728	—16	744	160
3	00	No fertilizer	1096		256	00	92	00	480	00	744	00	584	00
4	200	Kainit	956	—20	256	00	108	18	512	18	728	—14	560	—53
5	200 240	Cotton seed meal ... Acid phosphate	1256	392	376	120	170	82	712	203	904	163	896	254
6	200 200	Cotton seed meal ... Kainit	812	60	304	48	140	53	640	117	824	84	864	199
7	240 200	Acid phosphate ..... Kainit	720	80			68	—18	544	6	776	38	712	12
8	00	No fertilizer	536				84	00	552	00	736	00	728	00
9	200 240 200	Cotton seed meal ... Acid phosphate ..... Kainit	848	312			164	80	448	—104	888	152	768	40
10	200 240 100	Cotton seed meal ... Acid phosphate ..... Kainit	960	424			248	164	528	—24	1072	336	1016	288

Compliments of
E. Mead Wilcox

BULLETIN NO. 132. **APRIL, 1905.**

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

Diseases of the Apple, Cherry, Peach, Pear and Plum; With Methods of Treatment.

By

E. MEAD WILCOX, PH. D. (Harvard)
Plant Physiologist and Pathologist.

Opelika, Ala.:
The Post Publishing Company.
1905.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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INTRODUCTION.

The rapid increase in the fruit growing industry in this State within recent years has made it necessary that more and more attention should be given to the diseases of these plants by the Experiment Staation and the fruit-growers themselves. A large number of letters reach this department during the year asking for information regarding these diseases and the best method of controlling them and these letters cannot in most cases be properly replied to by letter alone. They indicate also a growing interest in these matters and seem to indicate that the time has arrived to place before our people such information as is now available regarding these matters. To supply this evident need this Bulletin has been prepared.

We have thought it best to depart somewhat from the common method of presenting such matters and have made the attempt to arrange the facts and suggestions under such definite headings as will best serve to indicate what sort of information must be had before one can hope to successfully control diseases of cultivated plants. More than this we have looked upon the diseases from the standpoint of the diseased plant and have included, therefore, no statements regarding the organism causing the diseases where this would not conduce to a clearer understanding of the disease itself and particularly of the methods of treatment suggested. The science of plant pathology owes much to mycology but its future advance and recognition depends upon its rather more sharp differentiation from "economic mycology."

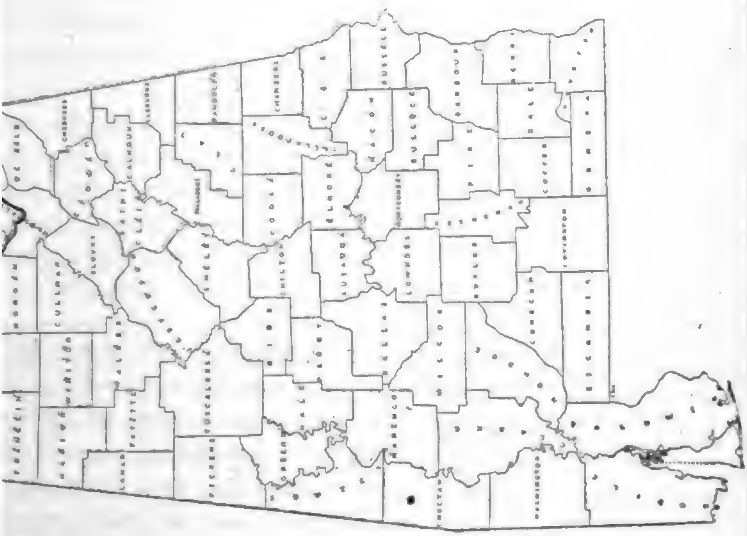
The plants are arranged in alphabetical order by their common names and under each are given, also in alphabetical order, the most important diseases of these

plants in our region. We have introduced no new common names for any of these diseases, but have employed the common names now in most common use or that are sanctioned by the leading authorities upon this subject. In cases where the same disease is known on more than one of the plants mentioned reference to the disease will be made under each, but its full description will be presented under the first plant mentioned or in connection with the plant in which the disease is here best known. If the disease shows specific differences in the different plants attacked mention of the facts will be recorded under each plant concerned. Methods of treatment are discussed under each disease and no "spray calendar" is given. It is believed the plan here adapted has several and peculiar advantages over the other method.

We have placed at the close of the discussion of each disease a bibliography of the disease. This bibliography is in no case complete, but is simply a select list of the more original and recent literature dealing with this subject. The majority of these references are to the literature of the State Experiment Stations and the Department of Agriculture. To these and other sources I am indebted for information here presented and the references to this literature are here included to show readers of this Bulletin that further reading and study of this matter of plant diseases may readily be made in the publications mentioned that may in most cases be had for the asking.

One of the principal purposes of this Bulletin is to enable fruit growers to recognize some of the common diseases of the plants mentioned in order that they may assist this department in securing data each year of the distribution and severity of the diseases in the various counties of the State. The method employed here in recording this information is well shown by the figures on pages 82 and 83. The first one shows the front and the last one the back of a record form so made as to be employed in a regular loose

leaf holder. We wish specimens and information regarding each disease from every county of the State where it is to be found and shall be glad to afford any who care to assist us in gathering this information any special directions they may desire. Specimens of diseased conditions of any plant are at all times desired and these and letters regarding such subjects should be directed to the Department of Plant Physiology and Pathology of the Experiment Station.



(Devised by E. Mead Wilcox, 1904.)

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APPLE.

BITTER ROT.

HISTORY AND DISTRIBUTION.

The bitter rot of apples, known also as the ripe rot or anthracnose of the fruit, certainly made its appearance in America previous to 1867 and has attracted much attention from that time to date. In the United States the disease is found in practically every State east of and including Kansas, Oklahoma and Texas; the most serious outbreaks of the disease have occurred in Oklahoma, Indian Territory; southern Illinois, Ohio and Indiana; Kentucky, West Virginia, Virginia, eastern North Carolina, western New York; Delaware, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New Jersey and Alabama.

The fungus causing this disease may be fairly said to be found the world over wherever the apple is grown and, in addition to the apple, has been found on the following hosts: pear, tomato, grape, peach, nectarine, apricot, pepper, egg plant and squash. It remains to be determined whether the fungus occurring on these various hosts is identical.

SYMPTOMS.

The bitter rot or ripe rot of apples is a fungus disease of the ripening fruit producing in another form a canker of the smaller limbs of the apple tree.

The first sign of the disease is to be found in the form of a small discoloration just beneath the skin of the apple. This spot, as it enlarges, becomes more and more sunken and the rotting of the apple proceeds towards the core. When the spots reach a size of about a half inch in diameter small blackish bodies appear in a circular arrangement beneath the skin of the apple (Plate I, Fig. 1.). These blackish

bodies are the fruiting bodies of the fungus and soon project from the surface of the diseased spot. As these fruiting bodies break through the surface of the apple the spores produced in them are allowed to escape. The spores are held together in the form of stringy pinkish masses which are quite conspicuous, particularly on dry quiet nights when the spore masses are oozing out.

As the disease progresses other rings of fruiting bodies will appear outside of the one first formed and in time there may be a half dozen or more of these concentric rings. If the climatic conditions are unfavorable to the rapid development of the fungus the rings of the fruiting bodies will not be so definite or may be absent entirely. From the original point of infection the fungus may grow out until the whole apple is rotted—though there is at all times a rather sharp line of separation between the healthy and diseased portions of the fruit. If infection occurs at more than one point the rings of fruiting bodies from the several infections will ultimately unite with one another.

The general effect of the fungus is to hasten the maturity of the apple and lead to the well known falling of the apples. This falling may occur at any stage in the development of the disease. In fact the premature falling of the fruit is one of the most conspicuous symptoms of this disease.

During the summer of 1902 a Mr. Simpson, of Illinois, a large fruit grower of that State, noticed that in many cases there was to be found a canker on the limb that he suspected of being the source of infection from the fact that the canker was often found at the top of an inverted cone formed by the diseased apples on the tree. A careful investigation of this matter by Blair and Burrill and by Von Schrenk and Spaulding has established this suspicion of Mr. Simpson as a fact. They were able to produce the typical bitter rot by inoculation of healthy apples with spores produced in these limb cankers and also to produce the limb canker through inoculation with spores obtained from dis-

eased apples. This very important discovery introduced into the treatment of the disease a new factor of immense importance.

These cankers appear most generally on the smaller limbs and their general appearance is well shown in Fig. 2 on Plate II. There are other cankers of apple trees and of other trees due to various causes, but whenever the bitter rot of apples is found on trees on which cankers like those shown in the above figure occur the removal of the cankers would be advisable even in advance of a demonstration of the connection between the two troubles.

Relationship of Disease to Climatic Conditions.

The first appearance of the trouble on the apple may be expected during July in this latitude, though in the northern apple growing districts this is generally delayed until August. The exact time depends much upon the climatic conditions that prevail at the time and during the spring.

The green fruit is generally quite immune, a fact that may be due to the larger amount of malic acid in immature fruits as compared with ripe fruits. And it is this rapid destruction of the ripe fruit just when the owner is about ready to gather in the crop that makes the trouble so much dreaded!

Warm and sultry weather affords the best chance for the rapid development of the fungus and the appearance of a regular bitter rot epidemic. On the contrary in cool dry summers the trouble need not be much feared. Nights with much dew alternating with hot days will greatly promote the development of the fungus.

The time of first appearance of the trouble on the fruits may also be much influenced by the condition of the spores, as to ripeness, in the cankers and the mummies, to be described later. If a cold spring has delayed the formation of these spores then the rot will be late appearing on the fruit itself.

Economic Importance.

We cannot do better to emphasize the importance of this disease than to mention the statement of the President of the National Apple Shippers' Association who said, "the damage to the apple crop of the United States in 1900 from bitter rot was $10,000,000.00." The destruction of 75 per cent. of the crop by this disease is not very unusual and in many cases the owners of apple orchards have preferred to lease the orchard for a mere trifle than to run the risk of getting no returns at all. Von Schrenk and Spaulding say, in speaking of this disease, that "It has probably done more to discourage apple growing in many regions than all other troubles, including both fungus and insect diseases combined." In our State the disease has caused great losses in many places, but so far no very systematic attempt has been made to control the disease or to determine its exact distribution.

Aetiology.

The bitter rot of apples and the associated canker of apple limbs are produced by the fungus now known as *Glomerella rufomaculans* (Berk.) Spaulding and Von Schrenk.

Remedial Measures.

The treatment against this disease may, in the light of our present knowledge, be grouped under three headings: (1) removal and destruction of all diseased apples from the tree and from the ground, (2) removal of the cankered limbs, and (3) spraying with the regular Bordeaux mixture as directed below.

The spores formed on the apples that fall to the ground during the season and those on the apples that dry up to form mummies on the tree may live over the winter and thus constitute sources of new infection during the following spring. If only a few trees are infected it will cer-

tainly pay well to watch the spread of the disease and immediately pick and destroy by burning or burying in the ground every apple as soon as the disease appears upon it. In this way the further spread of the disease to other trees in the orchard will be largely prevented. And then all rotten apples on the ground should be gathered up and destroyed.

The limb cankers should be removed during the late fall or winter as they can then be seen more readily than they can when the trees are in leaf. If cankers are found on the smaller limbs as is generally the case, these limbs may be removed entire, but if found on the trunk or very large limbs it may be best to carefully cut out the cankered portion and paint over the wound carefully with white lead paint of tar. It seems certain now that the removal of all these cankers will do much to lessen the spread of the disease in the orchard by removing one of the sources of new infection.

In addition to the two above named precautions the trees should be carefully sprayed with Bordeaux mixture at least once before the buds open and then at intervals of ten days until the fruit is about ripe.

BIBLIOGRAPHY.

Alwood, W. B.

1894. Ripe rot, or bitter rot, of apples. Bull. Va. Exp. Stat. 40:57—82. pl. 1—2.

1904.* Orchard Studies—XV. The bitter rot of apples. Bull. Va. Exp. Stat. 142:249—279. pl. 1—4.

Burrill, T. J., and Blair, J. C.

1902. Prevention of Bitter Rot. Circ. Ill. Exp. Stat. 56:1—3.

1902. Bitter Rot of Apples. Bull. Ill. Exp. Stat. 77:351—366. fig. 1—12. pl. C.

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*This Bulletin bears the date November, 1902, on its cover, but within contains the statement "Issued February 20, 1904."

Garman, H.

1890. The bitter rot fungus of apples. (*Gloeosporium versicolor.* B. & C.) Rept. Ky. Exp. Stat. 2—1889; 43—45. fig. 13—15.

Halsted, B. D.

1892. Apple Bitter Rot or Ripe Rot. Bull. N. J. Exp. Stat. 86:16.

Longyear, B. O.

1904. Bitter rot, ripe rot, anthracnose. (Glomerella rufomaculans (Berk.) Spaulding & Von Schrenk.) Special Bull. Mich. Exp. Stat. 25:9—10. fig 4—5.

Stinson, J. T.

1894. Bitter Rot, Bull. Ark. Exp. Stat. 26:33—35.

1901. Preliminary report on bitter rot or ripe rot of apples. Bull. Mo. Fruit Stat. 1:21 pp.

Von Schrenk, H., and Spaulding, P.

1903—The Bitter Rot of Apples. Bull. Bureau Plant Ind. U. S. Dept. Agr. 44:54 pp. pl. 1—9. fig. 1—9.

BLACK ROT.

This disease has been known for some time being reported from Illinois for example as early as 1878. It probably occurs in every apple orchard and is often confused with the bitter rot.

Symptoms.

Brownish decayed spots appear on the apple generally near the stem and often near the flower end. This rotted area soon turns black and the rotting proceeds towards the center of the apple. There is no such sharp demarkation between the rotten and healthy portions of the apple as exists in the case of the bitter rot and this is one method of distinguishing the two diseases from each other. The surface of the decayed spot becomes somewhat depressed.

Finally the apple shrivels up more or less and becomes a small and hard "mummy."

This disease does not occur as a rule on green apples except in cases of injury to the apple by wounds or insects. It is often abundant on "windfalls." It is also one of the chief causes of rotting of apples in the market.

On the leaves the same fungus often causes rather serious damage through the formation of rather large and irregular brownish spots.

The old dead twigs on unpruned trees may often become breeding places for this fungus from which spores may be scattered by the wind. The fungus was once thought to live on the twigs merely as a saprophyte but is now known to cause a serious canker of apple twigs. (See Canker of Apple on page 91.)

Aetiology.

It is produced by the fungus *Sphaeropsis malorum*, Berk. The fruiting stage consists of numerous rather small black pustules that develop on the surface of the diseased apple. The pustules develop as a rule only after the rotting is fairly well advanced.

These pustules are roundish conceptacles, with black or purplish walls, containing the spores. The spores ooze out as small white threads. The spores are at first white, but soon become deeply colored.

Treatment.

The disease may be controlled by spraying with Bordeaux mixture, making the first application before the leaves appear and subsequent ones at intervals of about two weeks. (See Fig. 6 on Plate II.) Decayed fruit should be removed from the trees and the ground and destroyed and "mummy" fruits should not be allowed to remain on the tree over winter.

Since the fungus causing this disease is also shown to

be the cause of a canker, care should be taken to remove or treat cankered limb as suggested under the bitter rot.

BIBLIOGRAPHY.

Clinton, G. P.
1902. Black Rot. Sphaeropsis malorum Berk. Bull. Ill. Exp. Stat. 69:192—193. fig. 2 on pl. B.

Garman, H.
1895. Spraying Experiments in 1895. Bull. Ky. Exp. Stat. 59:111—129. fig. 501—508.

Scribner, F. L.
1890. Black rot of the apple. Fungus diseases of the grape and other plants and their treatment. 81—83. fig. 1606.

CANKER.

HISTORY AND DISTRIBUTION.

This disease was first reported from New York State, but is now known to have a much wider distribution. The fact of its being caused by the fungus producing the well known black rot of the apple, pear and quince fruits would naturally lead one to suspect that the distribution of the canker would be coextensive with the black rot.

SYMPTOMS.

In general a canker may be said to be the result of any "injury that destroys the bark and lays bare portions of wood." (Bull. 170 N. Y.) This particular canker is due to the action of a parasitic fungus that attacks principally the larger limbs. The trouble may be detected from the swollen appearance of the limbs and the rough dark colored bark. (Plate VII. Fig. 19.) Frequently in severe cases of canker the wood itself may be exposed and thus decay of the wood itself begins. The extent to which the canker affects the bark varies apparently with various conditions, but may be several feet.

The effect upon the tree is due to the interference with the circulation of the sap and the amount of injury will of course be in proportion to the surface area of the cankers. The tree may be simply weakened or may be killed outright.

Aetiology.

This canker is caused by the fungus *Sphacropsis malorum* Pk.

Treatment.

Cankered limbs should, if possible, be removed and burned. Where the cankers are found on the trunk or very large limbs it may be advisable to cut out the diseased spot and paint over the wound with some sort of paint or wash.

When spraying with Bordeaux mixture for other apple diseases if canker be present it would be advisable to thoroughly cover the limbs with the spray mixture.

Bibliography.

Beach, S. A., Lowe, V. H., and Stewart, J. C.

1899. Apple tree canker. (*Sphacropsis malorum* Pk.) Bull. N. Y. Geneva Exp. Stat. 170:382—383.

Chester, J. D.

1901. Canker in apple and pear. Rept. Del. Exp. Stat. 1900:43—46. fig. 4—7.

1902. Canker in Apples. Bull. Del. Exp. Stat. 57:10—11. fig. 6.

Hall, F. H., and Paddock, W.

1899. Canker: an enemy of the apple. Bull. N. Y. Geneva Exp. Stat. Pop. Edit. 163:1—6. pl. 1—2.

1900. Apple-tree cankers. Bull. N. Y. Geneva Exp. Stat. Pop. Edit. 185:1—2. pl. 1—3.

Paddock, W.

1899. The New York apple-tree canker. Bull. N. Y. Geneva Exp. Stat. 163:179—206. pl. 1—6.

1900. The New York apple tree canker. (Second Report.) Bull. N. Y. Geneva Sxp. Stat. 185:205—213. pl 1—4.

1901. The New York apple-tree canker. (Second Report.) Rept. N. Y. Geneva Exp. Stat. 19—1900: 342—350. pl. 53—55.

FLY SPECK.

History and Distribution.

This disease, aften referred to as "flies" and "blackbirds," was first reported in scientific literature in 1896 from Delaware. It is at present no doubt to be found practically wherever the apple is cultivated.

Symptoms.

This fruit-disease is marked by the appearance upon the fruit of a number of small spots of specks (Plate II. Fig. 5.) in areas that may be 1-4 of an inch or more in diameter. The skin of the apple around this area may become rather cloudy in color and if many of the areas unite with each other the whole surface of the apple may become sooty in appearance. The effects of the fungus do not extend below the surface of the apple, but in the most severe cases the apple may become somewhat shrivelled owing to the action of the fungus causing the disease.

The claim is made that the disease will spread upon apples in storage.

Aetiology.

The disease is due to the fungus known as *Leptothyrium pomi* (Mont. & Fr.) Sacc.

Resistance of Varieties.

This disease appears in ordinary seasons most severely upon the fruit of trees planted in low damp situations. During a very wet season, however, all sorts of trees will be apt to be affected without reference to their situation or resistance. Rhode Island Greening, Rome Beauty and Peck's Pleasant are very frequently badly injured by this disease.

Treatment.

One thorough spraying with the ordinary Bordeaux mixture when the apples are half grown or less will prevent the injury from this disease. In the case of smooth skinned apples this spraying should be done somewhat earlier to prevent the so-called "russetting" of the apples caused by the fungicide itself. See also treatment for sooty blotch.

Bibliography.

Halsted, B. D.

1894. Decays of Mature Apples. Rept. N. J. Exp. Stat. 1893:367—377. fig. 35—41.

Powell, G. H.

1896. A Fungus Disease of the Apple. Garden and Forest. 9:474—475.

Selby, A. D.

1897. Sooty fungus and fly-speck fungus—an old enemy in a wet season. Bull. Ohio Exp. Stat. 79: 133—134. fig. 8—9.

1900. Sooty Fungus and Fly-speck Fungus. Bull. Ohio Exp. Stat. 121:13—14. fig. 12.

HAIRY ROOT.

History and Distribution.

This disease was first reported by Stewart, Rolfs and Hall from Western New York in 1900, but is no doubt much more

widely distributed than our records in the literature show. We have here in Alabama a very similar if not identical disease of apple and peach.

Symptoms.

The affected trees have few or no large branch roots. The root system of the tree instead consists of a number of groups of hair-like fine roots springing from the main tap root. Fig. 16 on Plate VI shows one of the common forms of the disease.

Aetiology.

The cause of the disease is at present unknown. It may be associated with attacks of wooly aphis or with the crown gall, but may occur independent of both of these troubles. It does not seem with us to be found associated with any type of soil. Specimens of this disease are much wanted.

Bibliography.

Stewart, F. C., Rolfs, F. M., and Hall, F. H.

1900. "Hairy Root." Bull. N. Y. Geneva Exp. Stat. 191:300—301. pl. 2.

1901. "Hairy Root." Rept. N. Y. Geneva Exp. Stat. 19—1900:177—178. pl. 23. (A reprint from Bull. 191.)

RUST.

History and Distribution.

Apple rust is widely distributed and may be expected wherever apples and cedar trees are growing in close proximity to each other. In Alabama the rust is in many sections one of our most serious apple troubles.

Symptoms.

The disease may readily be detected by the circular yellowish spots (See Fig. 4 on Plate II.) that appear on the

leaves in May or June. Similar spots may also appear on the fruit.

Aetiology.

The apple rust here is produced by one stage of *Gymnosporangium macropus*, the other stage of which lives on the red cedar causing there the so-called "cedar apples," shown in Fig. 3 on Plate II. The spores produced in the gelatinous out growths from these gallls in early spring are the source of infection of apple leaves.

Treatment.

Spraying seems to be of no value in controlling this disease. Since cedar trees harber one stage of the fungus causing this disease it is of course advisable to remove the "cedar appless" or if possible the cedar trees themselves. A little attention to this matter will dispose of he rust problem in apple orchards.

Bibliography.

Chester, J. D.

1896. Apple Rust. Rept. Del. Exp. Stat. 8—1896: 63—69. fig. 6—10.

Galloway, B. T.

1889. Apple Rust. Rept. Secy. U. S. Dept. Agr. 1—1889:413—414.

Halsted, B. D.

1889. Apple Rusts. Rept. U. S. Comm. Agr. 1888:370—381. pl. 11—12.

1892. Apple Rust. Bull. N. J. Exp. Stat. 86:15.

Jones, L. R.

1891. Apple rust and cedar apples. Rept. Vt. Exp. Stat. 4—1890:139—140.

Wilcox, E. M.

1901. Apple leaf rust. Rept. Okla. Exp. Stat. 10—1901: 116—117.

SCAB.

History and Distribution.

It has been known as a serious apple disease since the early part of the 19th century. For example Curtis recorded it as common on apples in North Carolina in 1867. In this country its greatest injury seems to be in the Mississippi Valley. In this State no definite attempt has ever been made to the writer's knowledge to control it by spraying and in fact it has never attracted any great attention.

Symptoms.

Scab first makes its appearance early in the spring soon after the first leaves begin to unfold. It is during this time that the greatest amount of infection occurs, though there is a second period of infection in the fall which is largely responsible for the production of the mature winter stage. The scab may often be seen on the leaves and fruit of the lower branches showing that the probable source of infection was to be found in the leaves on the ground on which the fungus had wintered over. The first spots on the leaves are often on the lower side near the midrib—this being the first part of the leaf to be exposed while the leaf is unfolding.

On the Leaves.

The scab here is found in the form of roundish spots about 1-4 inch in diameter. Frequently several of these spots may unite with one another—particularly if they are near a large vein or the midrib where the fungus seems to grow more rapidly than elsewhere on the leaf. The spots have an olive green color.

On the Fruit.

The scab spots are roundish 1-8 to 1-2 inch in diameter and of an olive green color—frequently with a lighter colored margin. These spots may coalesce to some extent if conditions are such as to favor the growth of the fungus. The scab fungus grows more rapidly on young fruits than on older ones—due no doubt to the fact that the cuticle of the younger apples is more delicate. Old fruits for the same reason are not very apt to become infected. The cuticle over the "scab" may later in the season become broken and flaked off, exposing the dead tissues of the apple and giving the scabbed area a reddish brown color. The fungus also frequently causes the formation of a considerable amount of corky tissue—which in turn protects the apple from becoming infected at the scab spot by other fungi.

Winter Stage.

When the diseased leaves fall to the ground in the fall the mycelium that during the summer was confined to the space just beneath the cuticle, grows down into the tissues of the leaf. The deeper penetration into the leaf is made possible by the death of the leaf and the consequent partial decay of its tissues. These hyphae take on a reddish olive color and the cells composing them are larger than those formed during the summer. The fruiting bodies, perethecia, of the fungus are formed within the leaf. The spores are ripe by April or May and ready to produce the spring infection. Perethecia are often formed near the small spots on leaves produced by the autumn infection. The pustules are scattered or more generally gathered together in groups on a grayish spot that may mark the spot of the summer's scab. This stage of the fungus is not found elsewhere but on the leaves.

TREATMENT.

The scab may be prevented by spraying with Bordeaux mixture as follows:

(1.) Spray with Bordeaux mixture just before the flower-buds open.

(2.) Spray again just after the blossoms fall.

(3.) Spray 1, 2 or 3 more times at intervals of about 10 days.

The following results secured by Jones & Orton in Vermont, show the immense profits in spraying for the apple scab. They sprayed as follows:

1. April 27. Buds not open; with solution of copper sulfat 1 lb. to 20 gallons.
2. May 18. Leaves out—flowers not open; Bordeaux "1—10" to which was added 1-3 lb. paris green.
3. June 15. Blossoms fallen.
4. July 18.
5. August 3.

Comparison was made of trees sprayed five times and those sprayed three times (the last two sprayings being here omitted) and trees not sprayed at all. The following table shows the results clearly:

	Per cent. on the tree.	Per cent. fallen.	Total value of crop per tree.
Sprayed 5 times	60	40	$15.44
Sprayed 3 times	51	49	7.38
Not sprayed	33	67	2.15

When account is taken of the fact that the fungus causing the disease may winter over on the fallen leaves it appears advisable to rake up and burn fallen leaves at the close of the season.

The gain from spraying may fall into the following classes:

(1.) Actual gain in yield per tree.

(2.) An increased percentage of "selects" and No. 1." apples.

(3.) Prevention of falling due to scab .

(4.) Increase in vigor of the tree itself.

(5.) Reduction of the loss, often very serious, resulting from the attacks of various fungi causing a rotting about the scab spots of storred apples.

Influence of Weather.

The greatest injury from the scab may be expected during seasons having a cold damp spring. The amount of the injury in any given season is also no doubt in a measure dependent upon the amount of the mature *Venturia* stage produced on the fallen apple leaves—this in turn being influenced by the climatic conditions prevailing during the preceding fall and winter.

Aetiology.

Apple scab, a disease affecting the leaves and fruits of the apple, is caused by the parasitic, summer stage, *Fusicladium dendriticum,* of the fungus *Venturia inaequalis.*

Bibliography.

Beach, S. A.

1897. Wood ashes and apple scab. Bull. N. Y. Geneva Exp. Stat. 140:665—690.

Blair, J. C.

1899. Spraying apple trees, with special reference to apple scab fungus. Bull. Ill. Exp. Stat. 54:181—204. fig. 1—27.

Chester, F. D.

1895. Experiment in the treatment of apple scab at S. H. Derby's, Woodside, 1895. Bull. Del. Exp. Stat. 29:18—24. fig. 1.

1897. Experiment in the treatment of apple scab upon the farm of S. H. Derby, Woodside. Bull. Del. Exp. Stat. 34:14—19. fig. 3—4.

Clinton, G. P.

1901. Apple Scab. Bull. Ill. Exp. Stat. 67:109—156. pl. 1—4. fig. 1—34.

Detmers, F.

1891. Apple Scab. (*Fusicladium dendriticum,* Fckl.) Bull. Ohio. Exp. Stat. ii—Vol. 4. No. 9:187—192. pl. 5—7.

Fairchild, D. G.

1894. Apple Scab. (*Fusicladium dendriticum* (Wallr.) Fuckl.) Bull. Div. Veg. Path. U. S. Dept. Agr. 6:43—44.

Henderson, L. F.

1899. Apple Scab in the Potlatch. Bull. Idaho Exp. Stat. 20:77—95. pl. 1—3.

Jones, L. R.

1891. Black scab of apple. Rept. Vt. Exp. Stat. 4—1890:142.

1892. Apple and Pear Scab. Bull. Vt. Exp. Stat. 28:30—34.

1892. The prevention of apple and pear scab by spraying. Rept. Vt. Exp. Stat. 5—1891:132—133.

1893. Apple Scab. Rept. Vt. Exp. Stat. 6—1892:82—83.

1894. Apple and Pear Scab. Bull. Vt. Exp. Stat. 44:83—93. fig. 1—4, 8—9.

Jones, L. R., and Orton, W. A.

1898. Spraying for the prevention of apple scab in 1897. Rept. Vt. Exp. Stat. 11—1898:195—198. illust.

1899. Spraying for the prevention of apple scab. Rept. Vt. Exp. Stat. 12—1899:156—159.

Lawrence, W. H.

1904. The Apple Scab in Western Washington. Bull. Wash. Exp. Stat. 64:1—24 pl. 1. 2 fig. 1—5.

Powell, G. H.
1894. The Apple Scab. Garden and Forest. 7:297.
Scribner, F. L.
1888. Apple Scab. Rept. U. S. Comm. Agr. 1887:341—347. pl. 2.
Selby, A. D.
1899. Apple Scab. Bull. Ohio Exp. Stat. 111:95—115. fig. 1—7.
Trelease, W.
1884. The apple scab and leaf blight. (*Fusicladium dendriticum.* Wallroth.) Rept. Wisc. Exp. Stat. 1:45—56. fig. 6—8.

SOOTY BLOTCH.

History and Distribution.

This was first reported by Sturgis in Connecticut in 1898 on Rhode Island Greenings and Newton Pippins. It is now very widely distributed and together with the fly-speck disease, with which often associated, causes much damage to apples particularly during wet seasons or where trees are planted in low damp soil.

Symptoms.

The disease appears as irregular blotches (Plate II. Fig. 5.) upon the surface of the apple—these blotches are at first pale, but soon become sooty black in color and under a lens show a radiating appearance due to the manner of growth of the fungus causing the disease. No rotting of the fruit occurs since the fungus works entirely upon the surface of the fruit. It may with the fly-speck disease greatly reduce the market value of the fruit.

Treatment.

Both fly-speck and sooty blotch will be controlled by the

spraying against the scab. It may be necessary, however, to give one or two sprayings later in the season, say in July.

Aetiology.

The fungus causing this disease is generally referred to *Phyllachora pomigena*, though this matter demands further study.

Bibliography.

(In addition to the following consult the Bibliography given under Fly Speck.)

Beach, S. A., Lowe, V. H., and Stewart, F. C.
1899. Sooty Blotch. (Phylachora pomigena. (Schw.) Sacc.) Bull. N. Y. Geneva Exp. Stat. 170—388.

Sturgis ,W. C.
1898. On the cause and prevention of a fungoous disease of the apple. Rept Conn. Exp. Stat. 21—1897:171—175.

CHERRY.

BLACK KNOT.

History and Distribution.

Black knot has long been known and the extent of its injuries has frequently been brought home to plum and cherry growers in no uncertain manner. The plum industry of the famous Hudson river valley (N. Y.) was practically wiped out by this disease. Farlow, 1876, was the first to determine its exact cause concerning which the most various opinions had previously been entertained.

Its most serious injury has frequently been to plums, but cherries are by no means exempt. DeSchweinitz mentions

an epidemic of this disease that destroyed the cherry trees about Bethlehem, Pa., in 1790.

SYMPTOMS.

The black knot is a rough wart-like outgrowth (Plate VII. Fig. 18,) from the bark of twigs and branches in severe cases extending along the trunk for several feet. The first symptom is the swelling of the tissue just beneath the bark. This enlargement increases during the fall or growing season until the bark is ruptured. This exposed portion of the twig is soon covered with an olive green velvety coating composed of the reproductive hyphae of the fungus. A microscopical examination of the diseased portion at this time would show numerous erect hyphae bearing spores—the so-called summer spores. These are readily carried about by the wind and other agencies and serve to spread the disease during the growing season.

Later in the season the production of summer spores ceases and the velvety covering gradually disappears. The surface of the wart gradually becomes hardened and altered in color to a dark brown and finally to a dead black.

Pimples may be seen late in the fall covering the wart. In these are developed the winter spores called ascospores. These ascospores only develop during the winter and are capable of germination in February and March.

AETIOLOGY.

The disease is due to the fungus *Plowrightia morbosa.*

TREATMENT.

The diseased twigs should be removed after leaf-fall or before the winter spores are formed. Twigs that show in the spring or early summer the beginning of a "knot" should be removed and burned to prevent the formation of the summer spores. If such knots are simply cut off and allowed

to remain on the ground the summer spores may ripen and then be scattered to other trees.

Co-operation of entire neighborhoods must be secured to render the campaign against the black knot effective. Legislation has been resorted to in several States, but a healthy and intelligent public opinion is necessary in this as in many cases.

Bibliography.

Anon.

1892. Black knot of plum and cherry. *Plowrightia morbosa,* (Schw.) Sacc. Bull. N. Y. Geneva Exp. Stat. 40:25—34. fig. 4—10.

Bailey, L. H.

1892. The black knot of plum and cherry. The New York Law. Bull. N. Y. Cornell Exp. Stat. 49 451—454.

Beach, S. A.

1894. Some observations on the life history of *Plowrightia morbosa* (Schw.) Sacc. Rept. N. Y. Geneva Exp. Stat. 1893:686—688.

Beach, S. A., Lowe, V. H., and Stewart, F. C.

1899. Black knot. (*Plowrightia morbosa.* (Schw.) Sacc. Bull. N. Y. Geneva Exp. Stat. 170:431—432.

Farlow, W. G.

1876. The Black Knot. Bull. Bussey Inst. 1:440—454. pl. 4—6.

Humphrey, J. E.

1891. The Black Knot of the Plum. *Plowrightia morbosa* (Schw.) Sacc. Rept. Mass. State. Exp. Stat. 1890:200—210. pl. 1.

1893. The Black Knot of the Plum. *Plowrightia morbosa.* (Sz.) Sacc. Rept. Mass. State Exp. Stat. 1892:235—247. pl. 5.

Lodeman, E. G.
1894. Black Knot of Plums and Cherries, and Methods of Treatment. Bull. N. Y. Cornell Exp. Stat. 81:633—656. fig. 1—6.

GUMMOSIS.

Among the stone fruits such as cherry, peach and plum a "gum-flow" or gummosis is frequent and may become a serious menace to the life of the trees affected. This disintegration of the tissues of the affected plant may be brought about by a variety of causes. Hence gummosis is a generic term applied to the condition here described whatever be the cause. Massee has described a gummosis of the common flowering almond (*Prunus japonica*) due to the action of a parasitic fungus, and this seems to be the only case of gummosis so far demonstrated to be due to a parasitic fungus.

Excessive gum flow frequently leads to the formation of a canker. (See plum canker, page —.) Reports of outbreaks of gummosis in any of the trees mentioned will be gladly received.

Bibliography.

Massee, G.
1903. Gummosis of *Prunus japonica* (*Cladosporium epiphyllum*, Fr.) A Text-Book of Plant Diseases. 306—310. fig. 82.

LEAF SPOT.

History and District.

This disease occurs widely distributed on the leaves of cherry, plum and apricot and is frequently referred to as leaf blight.

Symptoms.

Minute spots at first appear soon after the first leaves are full grown and these are often only 1-6 inch or less in diameter. On cherry and plum leaves the spots may have a reddish margin. The spots enlarge to 1-8 inch or more in diameter, (See Fig. 21 on Plate VIII,) becoming at the same time dark and with a pale center. Often the diseased spots fall out of the leaf causing a shot-hole effect and then called "shot hole" disease. (See Plate VIII.)

The tree may become defoliated through the action of this disease and in that case may be much weakened so that it is more apt to be injured during the following winter. The damage in this direction is much greater if the defoliation occurs, as it is apt to in the plum, when the tree is in fruit.

Aetiology.

This disease is caused by *Cylindrosporium padi.*

Treatment.

The leaf spot may be controlled by the proper spraying with Bordeaux mixture, but in the case of the cherry the application of the spray at the time the tree is in fruit, the best time to control the disease, may cause the fruit to be stained with the spraying mixture so as to reduce its market value. However, it is well to apply Bordeaux just before the blossoms open and again just after they fall to partially control the leaf spot and fruit rot.

Bibliography.

Beach, S. A.

1894. Peventing Leaf Blight of Plum and Cherry Nursery Stock. Rept. N. Y. Geneva Exp. Stat. 12—1893:688—693. pl. 5—6.

1894. Preventing Leaf Blight of Plum and Cherry Nursery Stock. Bull. N. Y. Geneva Exp. Stat. 72:339—346. fig. 1—2.

1896. Plum Leaf Spot. Bull. N. Y. Geneva Exp. Stat. 98:5—14. pl. 1—5.

1896. Cherry Leaf Spot and Fruit Rot. Bull. N. Y. Geneva Exp. Stat. 98:15—17. pl. 1—5.

1897. Plum Leaf Spot. Rept. N. Y. Geneva Exp. Stat. 15—1896:384—401. pl. 25—29.

1897. Prevention of Fungous Diseases in Cherry Orchards. Rept. N. Y. Geneva Exp. Stat. 15—1896: 402—407.

Duggar, B. M.

1899. Notes on the Shot-hole Effect of Peaches and Plums. Bull. N. Y. Cornell Exp. Stat. 164:385—388. fig. 71—72.

Fairchild, D. G.

1892. Treatment of plum leaf blight in nursery rows. Bull. Div. Veg. Path. U. S. Dept. Agr. 3:63—65.

1892. Treatment of plum leaf blight in the orchard. Bull. Div. Veg. Path. U. S. Dept. Agr. 3:62—63.

1893. Plum leaf-blight. (*Cylindrosporium padi* Karsten.) Journ. Mycol. 7:253—255. pl. 28—29.

1893. Cherry leaf-blight. (*Cylindrosporium padi* Karsten.) Journ. Mycol. 7:249—252. pl. 26—27.

1893. Plum leaf-blight. (*Cylindrosporium padi* Karsten.) Rept. N. Y. Geneva Exp. Stat. 11—1892:659—662. pl. 27—28.

1893. Cherry Leaf-Blight. (*Cylindrosporium padi* Karsten.) Rept. N. Y. Geneva Exp. Stat. 11—1892:654—659. pl. 25—26.

1894. Plum Leaf Blight. (*Cylindrosporium padi* Karst.) Bull. Div. Veg. Path. U. S. Dept. Agr. 6:39—40.

Green, W. J.
1891. The "shot hole" fungus of the plum. Bull. Ohio Exp. Stat. ii—Vol. 4. No. 9:216—217.

Thaxter, R.
1891. Leaf Spot of Plums and Cherries Causing Defoliation. Rept. Conn. State Exp. Stat. 1890:102.

PEACH.

BROWN ROT.

History and Distribution.

It has been known as a serious enemy of the peach in the United States for over 20 years and in Europe for even longer. Whenever peaches, plums or cherries are grown in this country the brown rot is a most serious pest. During certain years the loss is made most noticeable by favorable weather conditions. Thus in 1900 the loss to the peach crop in Georgia was estimated to be 40 per cent. or from $500,000 to $700,000. Similar losses are reported from other places. In Kentucky it has been reported as a rather serious disease of apples, but with us it seems to be confined to the peach, plum and cherry. It has also been reported on the pear, quince and apricot in addition to the above.

Symptoms.

On the Flowers.

Under favorable climatic conditions the disease may attack the flowers before or after the petals have fallen. At first a slight discoloration will appear on some part of the flower and soon this spreads so as to give the whole flower a brown and withered appearance. In Alabama during 1897 an epidemic of this disease of the peach flower appeared that practically destroyed the peach

crop for that season. Foggy, rainy and very warm weather were the conditions then prevailing that made possible the germination of an unusual number of the spores, derived, as usual, from the old diseased "mummy" fruits adhering to the trees. The spores formed on the diseased flowers were then sources of infection for any fruit that was later developed.

On the Twigs.

On the peach and plum, particularly the peach, the mycelium of the fungus may grow down into the twigs from the flowers or fruits that are infested. This condition of affairs is often referred to as the "twig-blight" of the peach. (See also canker of plum on page 131.) If only one or two peaches are found on a twig the twig is apt to become infected at only one point and thus be girdled by the fungus, resulting in the death of the uninfested terminal portion of the twig. If several infested fruits occur on the twig it may become infested throughout its entire length.

On the Fruit.

Small brown spots appear—these rapidly enlarge and whitish tufts of spore-bearing hyphae may appear. The peach may fall to the ground or simply shrivel up and remain attached to the tree. (See Plate III.)

In the case of the plum the fruit may be infected for some time before any external evidence appears. As the plum begins to ripen, however, the ash grey tufts of spore-bearing threads appear. This difficulty of distinguishing between infested and healthy plums leads in many cases to serious losses in shipping these fruits.

Peaches also often suffer en route to market from this rot—particularly if the refrigeration is not properly attended to.

Treatment.

The brown rot can be effectually controlled by two lines of treatment: (1) spraying with Bordeaux mixture as explained below and (2) removal and destruction of all affected fruit from both the tree and the ground.

The trees should be sprayed with the Bordeaux mixture as follows:

1. Just before the buds open.
2. Just after the blossoms fall.
3. Ten days to two weeks later.
4. Keep the fruit covered with the Bordeaux mixture until ripening begins and then employ either the ammoniacal copper carbonat or a solution of dibasic copper acetat made by dissolving six ounces of the salt in fifty gallons of water. These two mixtures will not injure the fruit.

Too much stress cannot be placed upon the absolute necessity of removing from the tree all the diseased fruits since these are sources of infection and their presence upon the tree may lead to most severe attacks of the twig disease produced by this same fungus. The fruits that are allowed to fall to the ground after rotting may serve as the home of the perfect stage of the fungus and act as sources of infection during the next spring. Mummy fruits (Fig. 8 on Plate III.) should not be allowed to remain on the tree.

Aetiology.

The brown rot is caused by the fungus now known as *Sclerotinia fructigena*—the conidial or imperfect form of the fungus, however, known as *Monilia fructigena,* being the direct cause of the disease. The perfect form of the fungus has been found on old fallen peaches in Maryland and Georgia. Its discovery emphasizes the necessity of removing and destroying all fallen and mummy fruits.

BIBLIOGRAPHY.

Chester, F. D.

1892. Can Peach Rot be Controlled by Spraying? A preliminary report. Bull. Del. Exp. Stat. 19: 1—16. 1 fig.

1893. Can peach rot be controlled by spraying? A preliminary report. Rept. Del. Exp. Stat. 1892: 53—66. 1 fig.

1897. Experiment in the Treatment of Peach Rot Upon the Farm of J. W. Killen, Felton. Bull. Del. Exp. Stat. 34:4—13, fig. 1—2.

Cordley, A. B.

1899. Brown Rot. Bull. Oregon Exp. Stat. 57:1—15. 1 pl. fig. 1—7.

Galloway, B. T.

1889. Brown Rot of the Cherry. Monilia fructigena. Pers. Rept. U. S. Comm. Agr. 1888:349—352. pl. 5—6.

Garman, H.

1890. The brown rot fungus of plums, peaches, apples and cherries. (*Monilia fructigena.* Pers.) Rept. Ky. Exp. Stat. 2—1889:31—42. fig 9—12.

1893. An experiment on plum rot. Bull. Ky. Exp. Stat. 47:53—55. fig. 15. Also Rept. Ky. Exp. Stat. 6—1893:130—131. fig. 15—1894.

Newman, C. C.

1902. Brown Rot of Peaches and Plums. Bull. S. Car. Exp. Stat. 69:1—12. pl. 1—3.

Quaintance, A. L.

1900. The Brown Rot of Peaches, Plums and Other Fruits. Bull. Ga. Exp. Stat. 50:233—269. fig. 1—9

Smith, E. F.

1892. Peach Rot. Journ. Mycol. 7:92.

Townsend, C. O., and Gould, H. P.

1901. Notes on Spraying Peaches and Plums in 1900. Bull. Md. Exp. Stat. 71:115—127.

CROWN GALL.

HISTORY AND DISTRIBUTION.

Crown gall is a contagious disease affecting a considerable number of the smaller and larger fruit trees and plants. The disease has been reported upon the following plants: peach, almond, apricot, prune, plum, pear, apple, English walnut, raspberry, blackberry, cherry, poplar and chestnut. It is, however, not at all certain that the galls on all the above plants, though very similar in general appearance, are caused by one and the same organism.

SYMPTOMS.

The gall generally behaves as an annual growth—those that begin in the spring mature the same fall. But in this climate the galls that start in late summer or fall continue their growth through the winter season. It is strictly a nursery disease—seedlings 1 to 6 months old being most likely to become infected. The first gall in such cases generally appears on one side of the main root a few inches below the surface or near the "crown" of the seedling. On larger trees the galls genrally appear on the lateral roots though the crown is also commonly attacked in the case of large trees. (Plate V.)

The wart at first is a light colored clear or translucent mass of succulent tissue frequently attached to the plant by means of a slender stalk or neck. The galls grow very rapidly and the outer surface soon takes on a warty appearance and a reddish brown color. The parts of a gall that become dark colored have lost their power of growth —the discoloration being due perhaps to the action of various fungi attacking the gall. From the surface of such a discorored gall many new smaller outgrowths may appear.

Toward the end of the season the gall becomes badly decayed and may readily be broken away from the plant leav-

ing an ugly deep wound. During the following spring a new lot of gall growth may take place around the margin of the old scar. And if the gall be removed new growth may begin even in the center of the wound thus formed. (Fig. 14 on Plate V.) This process may continue until the resulting wound is so deep that the tree falls of its own weight.

If a section of rapidly growing gall be examined there will frequently be found through it numerous darker colored irregular spots that are centers of more rapid growth. These centers frequently become beautifully twisted nodules of woody tissue—after the gall matures and begins to decay many of thes curious nodules may readily be removed from the outer portion of the gall.

Spread of the Disease.

The disease has been widely scattered over the country by shipments of stock from infested nurseries.

Locally it is known that a single diseased tree may in a few years suffice to infect most of the trees in the orchard. The spores of the parasite are small and may be carried by the air and it is likely that the disease may be communicated from old decayed galls.

The careless wounding of the crown of a tree or the break in the bark produced by escaping "suckers" both make a pathway for the parasite to gain entrance into the tree.

Care should in all cases be taken to see that all removed galls and uprooted diseased trees be burned on the spot and not hauled through the orchard at all.

Aetiology.

Toumey in Arizona gave special attention to the crown gall on the almond and described as the cause of this disease a new species of slime mould which he called *Dendrophagus globosus*. As has been said it has never been demonstrated that this organism is the cause of the widely dis-

tributed crown gall on the various plants that were mentioned above. Toumey was able to communicate the almond disease to the peach and apricot, but failed to do so to the apple. Selby believes that the gall may be communicated from the raspberry to the peach, but Halsted came to the opposite conclusion. Much work remains to be done on this very important disease.

Treatment.

The best advice that can be given fruit growers relative to the crown gall is this—never plant trees from a nursery known to be infested with the disease and never plant trees showing the disease, If a diseased tree is planted it is practically certain that the tree will never amount to anything. And what is even more important one is thereby very likely to introduce the disease into the soil of the orchard. If a bundle of nursery stock has a single crown gall on any of the trees the whole lot of trees should be destroyed.

It is possible that some good may be done by inspecting the orchards annually and removing all galls that have formed at the crown of the trees. After carefully cutting away the gall the wound surface should be covered with a paste made of lime and blue vitriol. But it must be remembered that, though the galls at the crown do the most damage, the smaller galls on the roots, which cannot be removed after planting, will reduce the vitality of the tree. It is therefore certaint hat no amount of after treatment of any sort will make a diseased tree give as large a yield as a healthy one.

Bibliography.

Alwood, W. B.

1903.* Some observations on Crown Gall of Apple Trees. Bull. Va. Exp. Stat. 140:185—212. fig. 27—37.

*This Bulletin is marked "September. 1902," on the front cover, but on the last page are the words "Issued September 15, 1903."

Paddock, W.
1903. Crown gall. Bull. Col. Exp. Stat. 86:1—8. pl. 1—3.
Selby, A. D.
1898. Crown Gall of the Peach. Bull. Ohio Exp. Stat. 92:208—217. pl. 5—6.
1899. Communicability of crown gall. Bull. Ohio Exp. Stat. 104:211.
1900. Crown Gall. (Apple.) Bull. Ohio. Exp. Stat. 121:13. fig. 11.
1900. Crown Gall. (Peach.) Bull. Ohio Exp. Stat. 121:43. fig. 35—36.
1900. Crown Gall. (Pear.) Bull. Ohio Exp. Stat. 121: 48. fig. 41.
1900. Crown Gall. (Plum.) Bull. Ohio Exp. Stat. 121:48.
Smith, E. F.
1894. Stem and root tumors. Journ.Mycol. 7:376—377. pl. 38.
Toumey, J. W.
1900. An Inquiry into the Cause and Nature of Crown Gall. Bull. Arizona Exp. Stat. 33:1—64. fig. 1—31. 1 plate.

LEAF CURL.

History and Distribution.

The leaf curl of the peach is found practically wherever the peach is cultivated and is one of the most serious of all peach enemies. The total losses from curl in the whole United States have been estimated by Pierce to be as high as $3,000,000.00 in a single year.

Symptoms.

As soon as the young leaf buds begin to open the leaves

show the characteristic roughened surface and deeper green color. This "curling" of the leaves progresses rapidly as the leaves grow (Fig. 9 on Plate IV). A part only or all of the leaf blade may become affected. A mature leaf, affected with curl, may have a reddish color, but generally the diseased leaves become simply discolored.

The fungus also grows inside the terminal portion of the young twigs and causes these to become swollen and to take on a lighter, paler color. These swollen terminal portions of the twigs constitute the only home of the perennial portion of the fungus. The spring infection seems to take place largely from spores formed from the mycelium present in these swollen twigs. The leaves soon become covered with a greyish mealy coating—composed of the fruiting bodies of the fungus. The spores are produced in small sacs arranged parallel to each other and at right angles to the surface of the leaf. These asci are produced on the ends of hyphae that grow out through the epidermis of the leaf. Defoliation occurs soon after spore-formation.

Gummosis of affected twigs is frequently to be seen as a result of the action of this fungus.

The tree attempts to make up for the loss of leaf surface by forcing some of its dormant buds to grow—these buds may grow to give a healthy twig—but at the base will be left the swollen fungus-infested portion—constituting a dangerous source of infection for another spring.

Relationship to the Weather.

The epidemic character of leaf curl has been frequently noticed and attempts made to connect the sporadic character of the disease with some climatic factor. No very definite statements can be made further than the suggestion that the phenomenon referred to can perhaps best be explained as due to the influence of certain climatic factors upon the spores either at the time (a) they are being scattered or (b) during germination and infection of the tree.

Treatment.

Leaf curl may be prevented by

(1.) Spraying with Bordeaux just previous to the opening of the buds in the spring.

(2). Spraying again with weaker Bordeaux as soon as the petals of flowers have fallen; this is to prevent late infection from the ground or neighboring trees.

(3.) Spraying again with weak Bordeaux when the first leaves are full grown or when the spores of the fungus are developing. This is to prevnt summer infection and cover places where spores may lodge to pass over the winter.

Where winter spraying against San Jose Scale with the lime-sulfur-salt wash is conducted this treatment may suffice of itself to hold the curl in check.

Bibliography.

Atkinson, G. F.

1894. Leaf Curl and Plum Pockets. Contribution to the knowledge of the Prunicolous Exoasceae of United States. Bull. Cornell Exp. Stat. 73.

Duggar, B. M.

1899. Peach Leaf Curl and Notes on the Shot-hole Effect of Peaches and Plums. Bull. Cornell Exp. Stat. 164:367—388. fig. 64—72.

Murrill, W. A.

1900. The Prevention of Peach Leaf-Curl. Bull. N. Y. Cornell Exp. Stat. 180:319—334.

Pierce, N. B.

1900. Peach Leaf Curl: Its Nature and Treatment. Bull. Div. Veg. Phys. and Path. U. S. Dept. Agr. 20:1—204. pl. 1—30. fig. 1—10.

Selby, A. D.

1898. Leaf curl of the peach. Bull. Ohio Exp. Stat. 92:226—231. pl. 8.

1899. Further studies upon spraying peach trees and upon diseases of the peach. Bull. Ohio Exp. Stat. 104:199—216. pl. 1—3.

1899. Variations in the amount of leaf curl of the peach (*Exoascus deformans*) in the light of weather conditions. Proc. Soc. Prom. Agr. Sci. 1899:98—104.

1904. Peach Diseases iii. Bull. Ohio Exp. Stat. 148: 53—67. pl. 1—7.

ROSETTE.

History and Distribution.

The rosette is known from a few stations in the West, but is principally known from Georgia and a part of South Carolina. It is found in peaches and almonds and perhaps also in plums. It seems not to have attracted much attention in Georgia until about ten years ago, but is now known to be present in many counties in budded and seedling orchards and also in seedlings growing in out of the way places.

Symptoms.

The rosette is in some respects closely related to the yellows. It may attack only parts of the tree at first, but may appear suddenly in the spring attacking nearly the whole tree at once. In such cases all the leaf buds grow out into compact tufts of leaves or rosettes, whence the name. Fig. 10 on Plate IV shows some of these characteristic rosettes. If a tree is attacked all over it will die the following autumn, but if only one or more branches are first attacked then only the diseased branches will die after a period of about six months. The leaves in these rosettes are generally of a peculiar yellowish color. The lower leaves in the rosette are frequently much larger than the normal

leaves and have inrolled margins and are stiffer than the usual leaves of the peach. These outer larger leaves turn yellow and fall early in the season while the inner leaves are still green. If a tree is attacked in all parts it bears no fruit, but otherwise the fruit born will generally be apt to shrivel up while still green and fall off or it may ripen naturally.

The disease may be spread through budding or root grafting as has been demonstrated by many experiments. However, it is known that mere contact of diseased with healthy tissue is not sufficient to introduce the disease, but there must be a real union of the two tissues.

Aetiology.

Like the yellows the exact cause of rosette is yet unknown.

Treatment.

All trees which show the rosette in the spring should be at once dug up and burned. If any of the diseased leaves have fallen these should be gathered also and burned as they may serve as sources of infection.

Bibliography.

Johnson, W. G.

1896. Peach Rosette. Bull. Md. Exp. Stat. 42:160—162. fig. 7—8.

Selby, A. D.

1898. Rosette. Bull. Ohio Exp. Stat. 92:199.

Smith, E. F.

1891. Additional Evidence on the Communicability of Peach Yellows and Peach Rosette. Bull. Dept. Agr. Veg. Path. 1:1—65. pl. 1—38.

1894. Peach Yellows and Peach Rosette. Farmers' Bull. 17:1—20. fig. 1—7.

YELLOWS.

History and Distribution.

This distinctly American disease is known to affect, in addition to the peach, the almond, nectarine, apricot and plum. It seems to be widely distributed in the United States.

Symptoms.

"Prematurely ripe, red-spotted fruits, and premature unfolding of the leaf buds into slender, pale shoots, or into branched, broom-like growths, are the most characteristic symptoms of yellows." The reddish spots in the fruit extend from the skin to the stone and their presence is one of the best tests for the disease.

During the first season that the disease is present in any given tree it may confine its attacks to one or a few only of the branches, but in later years other symptoms may appear and these are principally the premature opening of the winter buds. This is most plainly seen in the fall after the tree has lost all its leaves. The shoots may at this time be produced from these prematurely opened buds and are then very conspicuous. Very feeble shoots may also appear on the larger branches of the tree and these also are rather conspicuous on account of their broom-like appearance. In the later stages of the disease or when the disease has been present in a tree for several years the yellowing of the leaves may become apparent and this condition has given rise to the common name, but this is not the most conspicuous symptom and has led many to confuse the disease with leaf curl and other diseases.

Aetiology.

The exact cause of the disease is not yet known, though it is generally looked upon as a so-called "physiological dis-

ease." As to its spread and its infectious nature we are certain. It may be present in a dormant condition in buds employed in the nursery for budding and the disease is often introduced into a new region in just this manner.

The disease is also known to be spread from living and dead trees affected with the disease to healthy trees in the same orchard.

Soil and climatic conditions certainly cannot be charged with the cause of a disease which possesses such an infectious or contagious nature and there is no good evidence to show that the disease is caused by bacteria or other vegetable organisms.

TREATMENT.

The only line of treatment that promises to control the disease is to dig and burn the roots and entire tree as soon as it shows certain symptoms of this disease. Spraying is of no value and special fertilization of the soil seems to be of no value in its control. "Pits" or seeds from diseased trees should never be employed in a nursery or elsewhere.

BIBLIOGRAPHY.

Bailey, L. H.

1890. The Peach Yellows. Bull. N. Y. (Cornell) Exp. Stat. 25:178—180.

1894. Peach Yellows. Bull. N. Y. (Cornell) Exp. Stat. 75:389—408. 8 figs.

Beckwith, M. H.

1894. Are Seedling Peach Trees Exempt From Yellows? Rept. Del. Exp. Stat. 6—1893:152.

Chester, F. D.

1890. Peach Yellows. Culture Tests. Rept. Del. Exp. Stat. 2—1889:92—94.

Johnson, W. G.

1896. Peach Yellows. Bull. Md. Exp. Stat. 42:157—160. fig. 5—6.

Maynard, S. T.

1890. Some observations on peach yellows. Bull. Mass. Hatch Exp. Stat. 8:6—12. fig. 1—6.

Powell, G. H.

1897. Peach Yellows in Nursery Stock. Rept. Del. Exp. Stat. 9—1897:168—173. fig. 1—5.

Selby, A. D.

1896. Peach Yellows. Bull. Ohio Exp. Stat. 72:193—206. fig. 1—5. pl. 1.

1898. Peach Yellows. Bull. Ohio Exp. Stat. 92:190—199. fig. 4—5. pl. 1—2.

Smith, E. F.

1888. Peach Yellows: a Preliminary Report. Bull. Div. Bot. U. S. Agr. 9:1—254. pl. 1—37.

1891. Additional evidence on the communicability of peach yellows and peach rosette. Bull. Div. Veg. Path. U. S. Dept. Agr. 1:1—65. pl. 1—38.

1893. Experiments with fertilizers for the prevention and cure of peach yellows, 1889-92. Bull. Div. Veg. Path. U. S. Dept. Agr. 4:1—197. pl. 1—33.

1894. Peach Yellows and Peach Rosette. Farmers' Bull. 17:1—20. fig. 1—7.

PEAR.

BLIGHT.

History and Distribution.

Pear blight, called also twig blight, and fire blight, is a contagious bacterial disease of pear, apple, quince and other pomaceous fruit trees. It is of very wide distribution and may be found practically throughout the United States east of the Mississippi river. It has been ascribed to the most

various causes, but the complete demonstration of its bacterial nature was made by Dr. Burrill, of Illinois, in 1879.

SYMPTOMS.

This disease attacks the flowers, young fruits and the young twigs and shoots, frequently working its way down through the bark to the larger limbs or even to the trunk itself. The disease has its most prominent symptom in the blackish discoloration of the leaves on the attacked twigs, but the bacteria do not as a rule find their way into the leaves except into the petiole and the larger veins. This discoloration of the leaves occurs in a week or more after the death of the branch on which they are found. (See Fig. 15 on Plate VI.)

There is much variation in the manner the attacked plant behaves or rather in the way the disease works. In some cases the affected twig is simply girdled and in that case the damage is not so great as when the whole twig or branch is killed. The very sudden death and rapid discoloration of the leaves has led many to suppose that the disease spreads in the tree more rapidly than it actually does. As a matter of fact the disease does not spread more than 2 to 10 inches per day in the twigs.

In the spring the blight first makes its appearance in the blossoms causing there the so-called "blossom blight." The most rapid distribution of the disease in the orchard takes place while the tree is in bloom. It is now known that the principle agency in this work is the various bees that visit these flowers for the nectar there found. In this nectar the bacteria causing the blight find a most suitable situation for rapid development. Bees going from flowers whose nectar contain even a few of these bacteria to healthy flowers on the same or other trees are very apt to carry some of the germs and thus rapidly spread the infection.

The disease also gains entrance to the plant through the tips of young shoots or twigs. This form of blight is often referred to as twig blight. In the case of nursery stock

not in flower the disease is more often carried about in this manner.

Aetiology.

Pear blight is now known to be due to *Bacillus amylovorus*, one of the bacteria. This discovery was made in 1879 by Dr. T. J. Burrill. By means of the usual inoculation experiments this has been demonstrated beyond a shadow of doubt. There can never be any blight in the absence of this species of bacteria, no matter how very favorable soil and climatic conditions may be.

It was once supposed that the germ might live over winter in the ground, but that is now known to be false. As a rule the blight ceases at the close of the growing season, but in some cases, particularly where new infection has taken place late in the season, the germs may live over winter in the twigs and slowly push out into the healthy bark during the winter. The blighted twigs hold their moisture longer than healthy twigs and this is naturally very favorable to the germ and besides it is known that the germ may be exposed to a freezing temperature without injury.

In the spring the rapid accumulation of sap in the twigs sets up a flow of gum from the twigs in many cases and if the germs are alive in any of the twigs they are naturally carried out by this gum flow. Bees and other insects are attracted to this gum and by this means the germs are carried to flowers at which point they rapidly multiply in the nectar and enter the twig.

Influence of Environment Upon the Disease.

The pear blight makes best headway during warm moist weather and is more or less retarded by cold, dry and sunny weather. The germ is very sensitive to dryness and in the old, dead and dry twigs the germs will all be found to be dead.

Treatment.

Disease resistant sorts--

Such sorts as the Keiffer and Duchess resist the blight more than the Bartlett and some others and in general the apple is much less injured by the disease than are the pear and quince. There seems to be no need of attempting to breed special resistant sorts when we consider the positive remedial measures mention below.

Cultivation and soil fertility—

In general we may state that a well cultivated. highly fertilized and rapidly growing tree is most apt to be attacked by the blight. The use of too much barnyard manure is particularly dangerous if the soil is already rich in nitrogenous matter. In some cases it may be well to avoid too excessive cultivation. In general any measure that will tend to check the too rapid growth of the tree will tend at the same time to protect the tree against the blight. Heavy pruning in the winter time, since it promotes rapid formation of much new wood in the spring, may also be avoided at times with good results.

Treatment—

The absolute destruction of every blight germ should be aimed at and may be secured by the pruning away and destruction of each and every blighted twig as soon as detected. These may be removed during the growing season, but it is best to do this very thoroughly at the close of the growing season. but before the leaves have fallen. The blighted leaves will then serve as a guide. Most careful inspection of the trees must be made during the winter and again early in the spring before new growth starts to make sure that no cases of living blight are allowed to remain in the orchard. This is important since these cases of blight that are allowed to live over winter are the only starting points for new infection in the following spring.

Bibliography.

Alwood, W. B.

1903.* On the Occurrence and Treatment of Fire Blight in the Pear Orchard. Bull. Va. Exp. Stat. 135:49—66. fig. 16—20.

Chester, F. D.

1901. Notes on Pear Blight. Rept. Del. Exp. Stat. 12—1900:38—43. fig. 1—3.

1901. Pear blight and pear canker. Bull. Del. Exp. Stat. 52:1—8. fig. 1—7.

Hutt, W. N.

1903. Pear Blight. Bull. Utah Exp. Stat. 85:45—52.

Waite, M. B.

1896. The cause and prevention of pear blight. Yearbook U. S. Dept. Agr. 1895:295—300.

*This Bulletin bears on the outside the date, April, 1902, but within contains the statement, "Issued June 30, 1903."

LEAF BLIGHT.

History and Distribution.

This disease has long been known to horticulturists as the "leaf blight" or "scald" of pear and as the "cracking" of the fruit. It occurs practically wherever the pear is cultivated. It was mentioned in this country early in the sixties.

Symptoms.

The prominent symptoms are the premature discoloration of the leaves and their falling off together with the frequent cracking of the fruit. This leaf fall may be sudden or more gradual, extending in the latter case throughout the growing season. Often the leaf fall is accompanied with a second blossoming—both together making a rather severe drain upon the food supplies of the tree.

Small reddish spots are first seen upon the leaves; these spots as they increase in size take upon themselves a more definite circular shape. At maturity the spots are provided with a white to reddish brown center and a darker raised border. The spots may unite with each other and thus the whole leaf may become affected. The spots may come to be seated upon a reddish brown discolored leaf or the leaf may turn yellow. In any case the leaves fall from the tree.

In many cases there is also a so-called "cracking of the pear" produced by the same fungus. Small reddish spots appear upon the fruit and these spots may rapidly increase in number and finally coalesce with one another to give the fruit a very much blotched appearance that will greatly reduce its market value. At the same time the growth of the spots may be accompanied by a cracking of the fruit and of course this cracking may make an entrance for the spores of the rot fungi that may cause much damage. The same fungus often attacks the young twig of the pear. The spots upon the green bark of these twigs are somewhat elongated, sunken and of a black color.

In each of the spots referred to above on either the leaves, fruits or twigs one may see one or more blackish spots just beneath the surface. These spots are the spore producing bodies of the fungus.

The petioles and leaf scales are also frequently attacked.

Aetiology.

This disease is produced by the fungus *Entomosporium maculatum.*

Treatment.

Fallen leaves should be gathered together and burned.

The disease may be controlled by spraying with Bordeaux mixture, as follows:

(1.) When leaves are half grown.

(2.) Three subsequent sprayings at intefvals of two weeks.

The sprayings after the second should be made with ammoniacal copper carbonat to avoid the "russetting" injury to the fruit often produced by the Bordeaux mixture.

Bibliography.

Chester, F. D.

1891. Experiments in the Treatment of Pear and Quince Leaf Blight. Rept. Del. Exp. Stat. 3—1890:69—77. fig. 3—6.

1891. The treatment of the leaf blight of the pear and quince. *Entomosporium maculatum,* Lev. Bull. Del. Exp. Stat. 13:4—16. fig. 1—3. 2 plates.

1892. Present status of knowledge on the treatment of pear leaf blight. Rept. Del. Exp. Stat. 4—1891:44—47.

Duggar, B. M.

1898. Some Important Pear Diseases. Bull. N. Y. Cornell Exp. Stat. 145:611—615. fig. 166—167.

Galloway, B. T.

1892. Experiments in the treatment of pear leaf blight, cracking, and scab. Bull. Div. Veg. Path. U. S. Dept. Agr. 3:36—47.

Southworth, E. A.

1889. Leaf Blight and Cracking of the Pear. *Entomosporium maculatum,* Lev. Rept. U. S. Comm. Agr. 1888:357—364. pl. 8—9.

Waite, M. B.

1894. Treatment of pear leaf blight in the orchard. Journ. Mycol. 7:333—338. pl. 32—33.

SCAB.

History and Distribution.

The scab of pear is, like the similar disease of apple, very

widespread and well known. It is known from practically every region where pears are grown.

Symptoms.

The symptoms are practically the same as for the apple scab. (See page 97.)

Aetiology.

This disease is due to the fungus called *Fusicladium pirinum.*

Treatment.

The diseased leaves should be plowed under or else gathered together and burned during the fall.

Two sprayings with Bordeaux mixture of the 1-10 formula should be made while the pear leaves are opening. Considerable good in controlling pear scab will result from a spraying with the lime-sulphur-salt mixture as late in the winter as possible.

Bibliography.

Beach, S. A.

1894. Experiments in preventing pear scab. Rept. N. Y. Geneva Exp. Stat. 12—1893:694—717. pl. 7—8.

1894. Experiments in preventing pear scab in 1893. Bull. N. Y. Geneva Exp. Stat. 67:183—204. fig. 1—2.

Galloway, B. T.

1892. Experiments in the treatment of pear leaf blight, cracking, and scab. Bull. Div. Veg. Path. U. S. Dept. Agr. 3:36—47.

Sturgis, W. C.

1894. Spraying for "Scab" of Apple and Pear. Rept. Conn. Exp. Stat. 17—1893:72—73.

1895. Experiments on the treatment of pear scab. *Fusicladium pirinum.* Lib. (Fckl.) Rept. Conn. Exp. Stat. 18—1894:135—137.

Smith, R. E.

1905. Pear Scab. Bull. Calif. Exp. Stat. 163:1—18. fig. 1—9.

PLUM

CANKER.

History and Distribution.

This disease is one of the most serious plum diseases we have to contend with in this State. Its distribution is somewhat uncertain.

Symptoms.

The real canker may be preceded by a gummosis. (See Gummosis under Cherry on page 106.) And this gummosis may be due to one of several causes. But when through gummosis or any other cause wounds of plum trees remain for a long time unhealed a canker may form on the twig.

It is probable that aside from wounding the most frequent source of the trouble is to be found in the attacks of the brown rot fungus. (*Sclerotinia fructigena.*) This fungus, as has been explained, works in the tissues of the twigs, particularly the fruiting spures, and finally may kill such parts. Then gummosis sets in to be followed soon by the canker. The canker may also follow severe attacks of plum pockets.

The Japan plums, being very subject to brown rot, and having soft coarse grained wood, are very apt to succumb to this canker.

Treatment.

The only treatment to be recommended consists in a thorough spraying to prevent the brown rot and plum pockets; and then the removal and burning of the cankered limbs.

Bibliography.

Selby, A. D.
1897. A twig disease with gum flow. Bull. Ohio Exp. Stat. 79:121—122. fig. 4.

Waugh, F. A.
1901. Plum Tree Canker. Rept. Vt. Exp. Stat. 13—1900:370—373. 1 fig .

PLUM POCKETS.

History and Distribution.

This disease on account of its very characteristic and striking symptoms has long been known to horticulturists and others. It is very widely distributed throughout the United States and has frequently been forwarded to me from various parts of this State.

Symptoms.

The vegetative portion or mycelium lives over winter in the younger twigs and grows out into the developing ovaries in the spring. All or most all of the parts of the ovary are affected and the action of the fungus is to greatly stimulate the tissues of the ovary so that a very rapid growth takes place. The result is a much swollen, somewhat irregular and spongy body of light yellowish or white color (Fig. 17 on Plate VII.) No stone is developed in this "plum-pocket" but the center is hollow or frequently traversed by loose threads of torn tissue.

The leaf buds and young twigs may also become modified by the action of this fungus to form very irregular spongy swollen objects. In this case the resulting hypertrphy varies with the stage at which the fungus begins its work. If the leaves are not far developed when attacked their normal form may never be attained, but the hypertrophy may affect only a portion of the leaf if its attack is made upon the leaf when partly grown.

Aetiology.

This disease is produced by the fungus *Exoascus pruni*—a species somewhat closely related to the one causing the leaf curl of the peach.

Treatment.

No special spraying treatment can be recommended, though the use of Bordeaux mixture would no doubt reduce the chance of infection. Diseased fruits, buds, leaves and twigs should be removed and burned.

Bibliography.

Atkinson, G. F.

1894. Leaf curl and plum pockets. Contribution to the knowledge of the prunicolous Exoasceae of the United States. Bull. N. Y. Cornell Exp. Stat. 73:329—330.

Galloway, B. T.

1889. Plum Pockets. *Taphrina pruni,* (Fckl.) Tul. Rept. U. S. Dept. Agr. 1888:366—369. pl. 10.

Halsted, B. D.

1892. Plum Pockets. Bull. N. J. Exp. Stat. 86:18.

FUNGICIDES.

Spraying is now looked upon by progressive and successful fruit growers as a necessary operation to be per-

formed if a full crop of fruit of a good quality is desired. In the case of a large and increasing number of diseases spraying has been demonstrated on a large scale to be of immense value. The financial gain from intelligent spraying depends solely upon the number of trees and the diseases prevalent in your orchards.

Spraying is plant insurance and, like life insurance, should be attended to before the disease has gained a foothold in the orchard. All trees should be sprayed every year whether the diseases usually present make their appearance or not.

A large number of formulas have been proposed by various investigators for special purposes. We give below directions in some detail for the preparation of the fungicides now most widely employed in connection with diseases mentioned in this Bulletin.

Bordeaux Mixture.

Bordeaux mixture consists of two essential ingredients, freshly slaked lime and copper sulfat, dissolved in water. The fungicidal action is entirely dependent upon the copper sulfat. The lime is added for the following reasons:

(1.) To prevent injury to the foliage.

(2.) To render the mixture more adhesive.

(3.) To render the mixture more readily seen after being applied.

Standard Formula for "1-10" Bordeaux.

We give here the formula of the common "1-10" Bordeaux mixture—so-called because it contains 1 pound of copper sulfat to 10 gallons of water.

Copper sulfat—5 pounds.
Quick lime (not slaked)—3 1-2 to 5 pounds.
Water—50 gallons.

A. Dissolve the 5 pounds of copper sulfat in hot or cold water in a wooden vessel. Dilute the solution thus secured to 25 gallons.

B. Slake the lime carefully and thoroughly. Dilute this milk of lime to 25 gallons.

C. Pour the two solutions thus obtained through strainers, at the same time, into the spray barrel. The mixture in the spray barrel should be stirred while the two solutions are being poured together.

D. Never attempt to mix the two solutions until they have been diluted as suggested above.

SPECIAL DIRECTIONS.

A. The copper sulfat may best be dissolved in cold water by suspending it in a coarse sack near the top of the water.

B. In slaking the lime add at first a small amount of water, preferably hot water, and then, as slaking begins, continue to add small amounts of cold water as needed. Never add much water at a time and never allow the lime to become dry.

C. For the more tender foliage of peaches and plums employ the "1-25" Bordeaux mixture, i. e., one containing 2 pounds of copper sulfat to 50 gallons of water.

D. In all cases use at least 2 pounds of lime to 3 pounds of copper sulfat.

E. A small amount of yellow prussiate of potash or potassium ferrocyanid dissolved in about ten times its bulk of water is often used as the so-called "ferrocyanid" test to determine whether or no the Bordeaux is properly made. A few drops of this solution are added to the Bordeaux. If a brown discoloration at once appears not enough lime has been used. Continue to add lime solution and stir until no discoloration appears upon adding a few drops of the ferrocyanid solution.

F. *The most important precaution is to unite the cold dilute solutions of lime and copper sulfat quickly and then to stir the mixture thoroughly.* (See Fig. 22 on Plate IX.)

Ammoniacal Solution of Copper Carbonat.

This mixture, designed for use when the Bordeaux might by adhering to the fruit injure its market value, is made according to the following formula:

Copper Carbonat—6 ounces.
Ammonia—3 pints.
Water—50 gallons.

The copper carbonat is to be dissolved in the ammonia, just as much ammonia being used as is required to dissolve the copper carbonat. This solution is then thoroughly stirred into the water.

Lime-Sulfur-Salt Wash.

This wash, long used along the Pacific coast to control the San Jose Scale, has recently sprung into favor for the same purpose in the East. We mention it here since its use seems to reduce various plant diseases, particularly apple scab and peach leaf curl. It is in a sense therefore both an insesticide and a fungicide. We give but one of the several formulas suggested:

Stone or lump lime—15 lbs.
"Flowers of sulfur"—15 lbs.
Salt—15 lbs.
Water—50 gallons.

"Place the lime in a kettle, or in a vat if steam is used, and slake it with hot water so that it forms an even white paste. Now add enough water to reduce the lime paste to a thin whitewash. The sulphur and salt are then added and should be thoroughly stirred in. If the mixture is not already boiling, bring it to this point and allow it to boil for one hour."

Stir the mixture frequently and at the end of the hour dilute the resulting mixture with hot water to make the required amount. Apply the wash, while hot, with any good nozzle to the trees.

This mixture is very caustic and must be applied to none

but dormant trees and should not be allowed to come into contact with the hands or face.

SPRAYING MACHINERY.

The type of spraying outfit to be employed and its size depends upon the size of the orchard in which it is to be employed. We can only briefly consider the matter here and refer to the two essential parts of any spray outfit: (1) the nozzle and (2) the pump and its accessory parts.

No nozzle of the multitude of forms upon the market is superior to those constructed on the principle of the Vermorel nozzle. These nozzles will give fairly good results even when the pump gives a very low pressure, though best results are secured with pressures of 100 pounds or higher. The "mistry" nozzle (Fig. 24 on Plate IX) made by the Goulds Mfg. Co., is of the Vermorel type and throws a finer spray with low pressures than do the Vermorel nozzles.

A good spray pump should have all working parts exposed to the spraying mixtures made of brass or some sort of bronze. And in addition neither rubber nor leather valves should be used. Assuming these two characteristics to be present the spray outfit is to be selected to fit the local conditions, particularly the number of trees to be sprayed. Fig. 23 on Plate IX, shows a well known type of pump to be attached to a barrel.

For further information on the subject of spraying outfits, consult the references in the Bibliography following and the catalogues to be secured from the following firms—well known as makers of spray outfits:

Deming Co., Salem, Ohio.

Field Force Pump Co., Elmira, N. Y.

Goulds Mfg. Co., Seneca Falls, N. Y.

Bibliography.

Anon.

1904. Spray Calendar. Bull. N. Y. Cornell Exp. Stat. 217:123—133.

Alwood, W. B.

1903*. Orchard Studies—XIV. The Lime-Sulphur Wash. Bull. Va. Exp. Stat. 141:213—246. fig. 38—54.

Beach, S. A., and Bailey ,L. H.

1900. Spraying in Bloom. Bull. N. Y. Geneva Exp. Stat. 196:399—460. pl. 1—3. fig. 1—6.

Beach, S. A., Clark, V. A., and Taylor, O. M.

1903. Spraying Mixtures and Spray Machinery. Bull. N. Y. Geneva Exp. Stat. 243:315—373. pl. 9—15.

Booth, N .O.

1900. A Test of Spray Nozzles. Bull. Mo. Exp. Stat. 50:87—115. fig. 1—10.

Corbett, L. C.

1896. Why, When, What and How to Spray. Bull. W. Va. Exp. Stat. 43:227—244. fig. 1—6.

Cordley, A. B.

1903. Insecticides and Fungicides. Brief directions for their preparation and use, including spraying, dusting, fumigating, etc. Bull. Oregon Exp. Stat. 75:21—43.

Fairchild, D. G.

1894. Bordeaux Mixture as a Fungicide. Bull. Div. Veg. Path. U. S. Dept. Agr. 6:1—55.

Galloway, B. T.

1896. Spraying for fruit diseases. Farmers' Bull. 38: 1—12. fig. 1—6.

Gossard, H. A., and Hume, H. H.

1904. Insecticides and Fungicides. Bull. Fla. Exp. Stat. 76:200—243. pl. 1—8.

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Green, W. J., and Selby, A. D.
1904. Calendar for treatment of plant diseases and insect pests. Bull. Ohio Exp. Stat. 147:41—53.

Lodeman, E. G.
1896. The Spraying of Plants. pp. xvii, 399. 92 figures. MacMillan & Co., N. Y. City.

Parrott, P. J., Beach, S. A., and Woodworth, H. O.
1904. The lime-sulphur-soda wash for orchard Treatment. Bull. N. Y. Geneva Exp. Stat. 247: 59—81. pl. 1—4.

Johnson, T. C.
1904. Mixtures and Appliances for Spraying. Bull. W. Va. Exp. Stat. 93:67—118. pl. 1—12.

Lowe, V. H., and Parrott, P. J.
1902. San Jose Scale Investigations IV. Bull. N. Y. Geneva Exp. Stat. 228:389—456. pl. 1—7.

Penny, C. L.
1893. The Preparation of Ammonical Solution of Copper Carbonate. Bull. Del. Exp. Stat. 22:1—16. fig. 1—2.

Orton, W. A.
1896. Methods of preparing Bordeaux mixture. Rept. Vt. Exp. Stat. 9—1895:88—92. pl. 4, fig. 13.

Smith, J. B., and Halsted, B. D.
1892. Spraying for Insect and Fungous Pests of the Orchard and Vineyard. Bull. N. J. Exp. Stat. 86:1—20.

Stone, G. E., Fernald, H. T., and Waugh, F. A.
1904. Fungicides, Insecticides, and Spraying Calendar. Bull. Mass. Exp. Stat. 96:1—16. 1 fig.

Stubenbrauch, A. V.
1902. Important Details of Spraying. Bull. Ill. Exp. Stat. 68:157—188. pl. 1—9. fig. 1—3.

Sturgis, W. C.
1898. Preparation and application of fungicides. Bull. Conn. State Exp. Stat. 125:1—16. 10 figures.

Swingle, W. T.

1894. An improved method of making Bordeaux mixture. Journ. Mycol. 7:365—371.

1896. Bordeaux Mixture: Its chemistry, physical properties, and toxic effects on fungi and algae. Bull. Div. Veg. Phys. and Path. U. S. Dept. Agr. 9:1—37.

Tillinghast, J. A., and Adams, G. E.

1899. Suggestions as to spraying. Bull. R. Is. Exp. Stat. 52:1—48. 1 fig.

Troop, J.

1898. Formulas for making insecticides and fungicides, and directions for spraying. Bull. Ind. Exp. Stat. 69:35—40.

Underwood, L. M., and Earle, F. S.

1896. Treatment of some fungous diseases. Bull. Ala. Exp. Stat. 69:243—272.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. Bitter rot of apples showing both isolated and confluent diseased areas and the concentric circles formed by the fruiting bodies of the fungus causing the disease. (From Bull. 44, Bureau of Plant Industry, U. S. Dept. Agr.)

Fig. 2. Limb cankers produced by the fungus causing the bitter rot. (From Bull. 44, Bureau of Plant Industry, U. S. Dept. Agr.)

Plate II.

Fig. 3. Twig of the red cedar showing one of the galls called "cedar-apples." This gall is produced by one stage of the same fungus that causes the rust of apple leaves. (Original.)

Fig. 4. The lower surface of an apple leaf showing the peculiar elongated horn-like fruiting bodies of the fungus causing the apple leaf rust. (From Rept, U. S. Dept. Agr. for 1888.)

Fig. 5. Fly speck and sooty blotch of the apple. (From Bull. 79, Ohio Exp. Stat.)

Fig. 6. The upper pile of apples is from the sprayed tree, the lower pile from the unsprayed tree—both together show the advantage in spraying against the apple black rot. (From Bull. 59, Ky. Exp. Stat.)

PLATE III.

Fig. 7. Brown rot of peaches. (From Bull. 50, Ga. Exp. Stat.)

Fig. 8. "Mummy" peaches, killed by the brown rot diseases, adhering to the tree and thus constituting a very fruitful source of new infection. (From Bull. [illegible], Ga. Exp. Stat.)

PLATE IV.

Fig. 9. Leaf curl of peach. (From Bull. 20, Div. Veg. Phys. & Path. U. S. Dept. Agr.)

Fig. 10. Rosette of peach. (From Journ. Mycol. Vol. 6.)

PLATE V.

Fig. 11. Longitudinal section of a root affected with crown gall. (From Bull. 33, Arizona Exp. Stat.)

Fig. 12. Crown gall; the upper left hand figure shows gall on Lombardy poplar, the upper right hand figure on pear and the two lower figures on peach. (From Journ. Mycol. Vol. 7.)

Fig. 13. Crown gall on apple; this gall appeared at the point where the graft was inserted shown at "A" in the figure. (From Bull. 93, Ky. Exp. Stat.)

Fig. 14. Crown gall showing the growth of new gall tissue after the removal of the old gall. (From Bull. 33, Arizona Exp. Stat.)

PLATE VI.

Fig. 15. Pear blight. (Original.)

Fig. 16. Hairy root of peach. (From Rept. Geneva N. Y. Exp. Stat. for 1900.)

PLATE VII.

Fig. 17. Plum pockets. (From Rept. U. S. Dept. Agr. 1888.)

Fig. 18. Black knot on plum. (From Prof. Farlow's paper in Bull. Bussey Institution, 1876.)

Fig. 19. Apple canker. (From Bull. 163, N. Y. Geneva Exp. Stat.)

PLATE VIII.

Fig. 20. "Shot-hole" affect produced on Japan plum leaves by improper spraying. (From Bull. 164, N. Y. Cornell Exp. Stat.)

Fig. 21. Cherry leaf-spot disease. (From Report N. Y. Geneva Exp. Stat., 1896.)

PLATE IX.

Fig. 22. Jars showing, after one hour's standing, the amount of settling of the precipitate in Bordeaux mixture made in the following ways. The lower light colored part in each figure is the precipitate:

A. Dilute lime poured into dilute sulfat slowly.
B. Dilute sulfat poured into dilute lime slowly.
C. Made as in E, but using hot lime milk.
D. Made as in E, but less thoroughly stirred.
E. Properly made from dilute solutions, quickly united and thoroughly stirred.
F. Made as in E, but with concentrated solutions.
G. Properly made mixture, one day old.
H. Old Bordeaux mixture, two weeks old.
I. "Bordeaux Powder" mixed with water.

Fig. 23. One example of the barrel-type of spraying apparatus. (From Bull. 243, N. Y. Geneva Exp. Stat.)

Fig. 24. "Mistry" spray nozzle. (Cut loaned by the Goulds Mfg. Co., Seneca Falls, N. Y.)

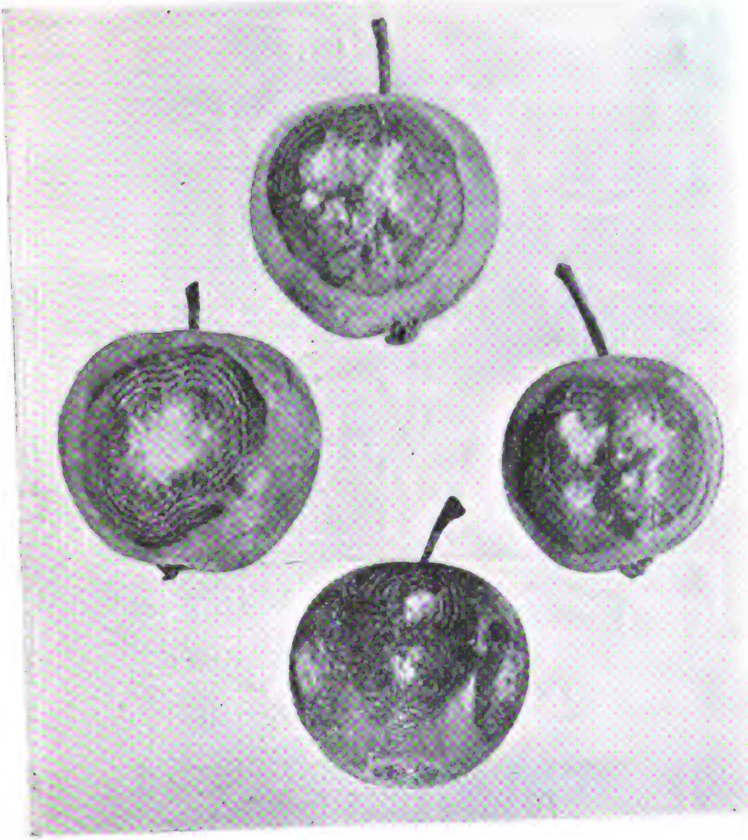


Fig. 1.

Fig 3.

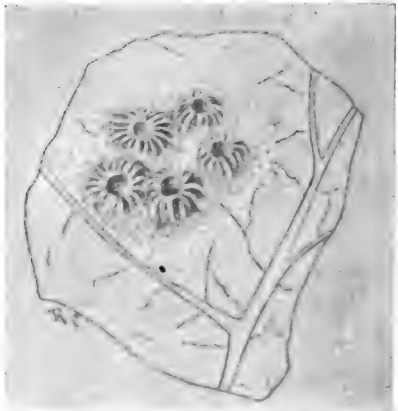


Fig. 4.

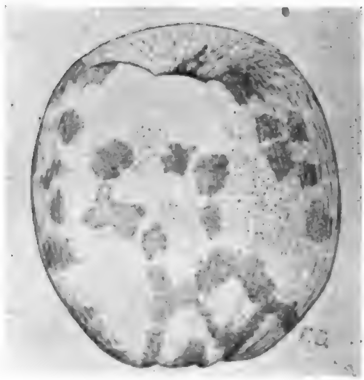
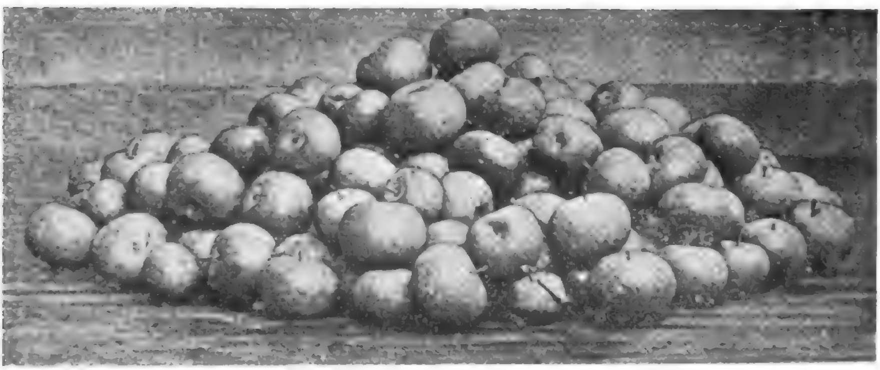


Fig 5.



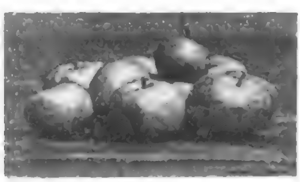


Fig. 7.

Fig. 9.

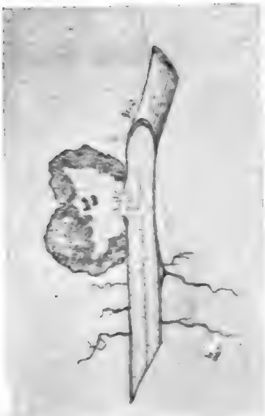


Fig 11.

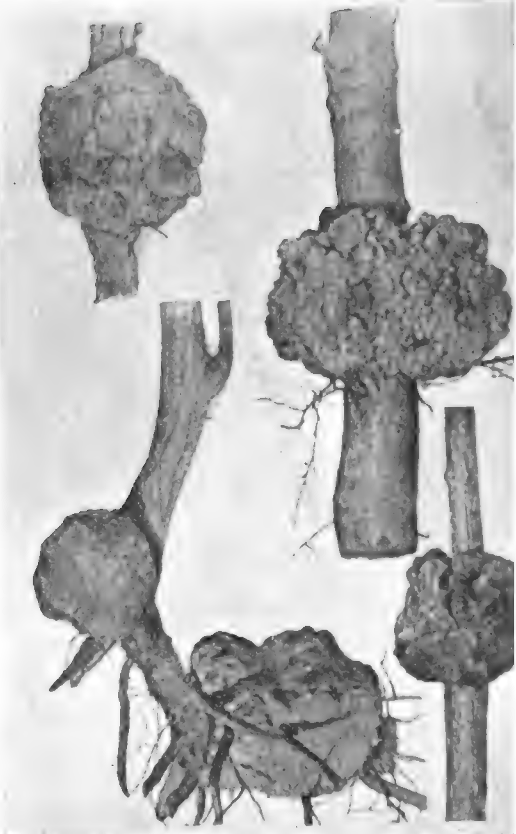


Fig 12.

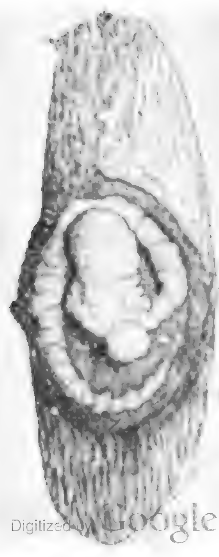


Fig. 15.

Fig. 17.

Fig. 18.

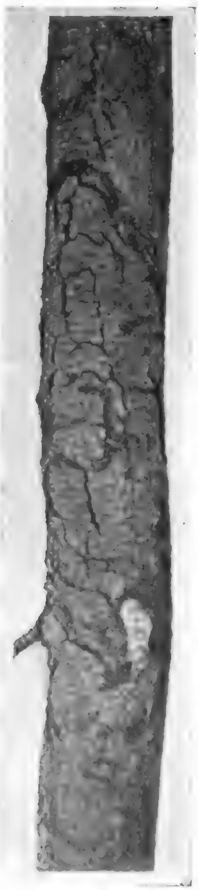
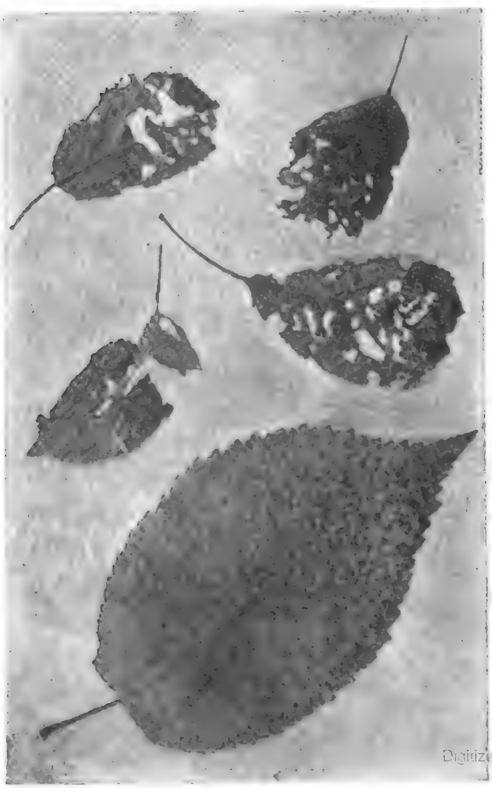


Fig. 20.



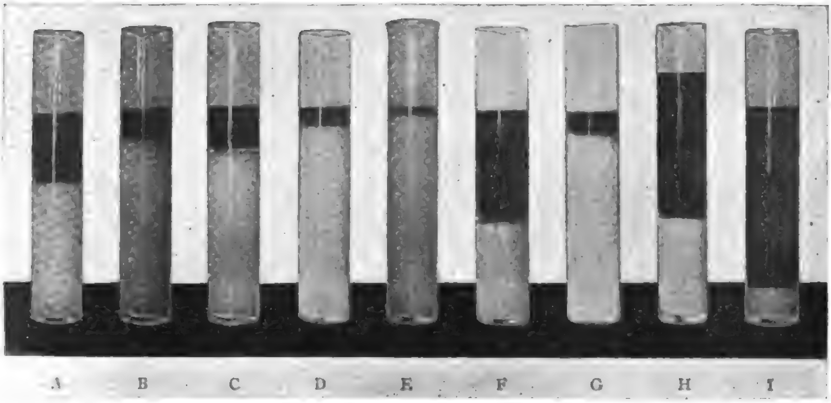


Fig. 22.

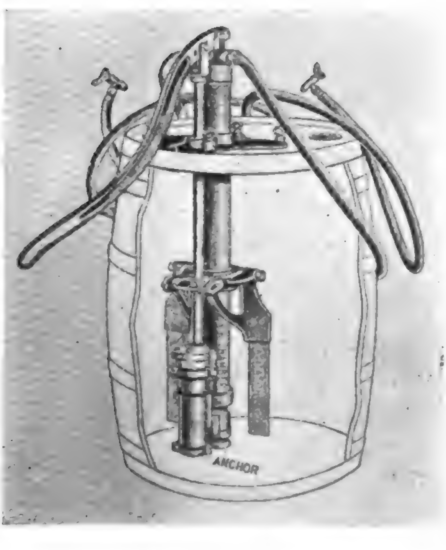


Fig. 23.

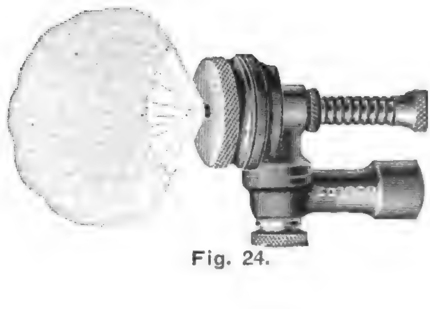


Fig. 24.

BULLETIN NO. 133. DECEMBER, 1905.

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

The Manufacture of Cane Syrup.

By

B. B. ROSS

Chemist.

Opelika, Ala.:
The Post Publishing Company.
1905.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

THE MANUFACTURE OF CANE SYRUP.

By B. B. Ross.

The Chemical Department of the Experiment Station has, within the past few years, issued two bulletins of the regular series, and at least one press bulletin, upon the subject of syrup making, but owing to the extent to which this industry has progressed in this State and on account of the numerous inquiries which have reached this office with regard to methods of clarification and of manufacture of syrups, it is deemed advisable to issue the present bulletin, which is designed to furnish fuller and more detailed information upon his subject than has been supplied by previous publications of this department.

The official reports of the twelfth census of the United States revealed the fact that sugar cane was grown and cane syrup manufactured in forty-four out of the sixty-six counties of the State and while these statistics indicate a wider distribution of this crop throughout the State than has been generally supposed, the area of profitable and satisfactory cultivation of sugar cane would have to be restricted to a considerably smaller number of counties, although it can be produced with greater or less success throughout the whole of Southern and Middle Alabama. In many of these counties patches of no larger area than from one-half to one acre are to be found in cultivation, while in the Southernmost tier of counties of the state some tracts of from ten to fifty acres are being devoted to cane growing for syrup production.

As regards the date of the introduction of sugar cane culture in Alabama, no definite or authentic information can be secured and there is even some difference of opinion as to how and where this important saccharine plant reached this continent. Dr. Stubbs, formerly Director of the Louisiana Sugar Experiment Station, who has investigated quite

carefully and critically the history of the sugar cane, is inclined to the opinion that Cochin China or Bengal was its original habitat, the cane plant being introduced successively into Arabia, Nubia, Ethiopia and Egypt, while, after the crusades, it found its way to Syria, Cyprus and Sicily. Some four centuries ago it was introduced into Madeira and the Canary Islands, and, until the beginning of the Nineteenth century, practically the whole of the sugar consumption of Europe was obtained from these islands.

Soon after the discovery of San Domingo, sugar cane culture was inaugurated in that island, and later, sugar cane was carried from there to South and Central America, to Mexico, to other islands of the West Indies, and finally in 1751 to Louisiana. Although attempts were made at that early period to grow cane and produce sugar in the vicinity of New Orleans, it appears that the first efforts were entirely unsuccessful, and it was not until about 1794 that Etienne de Bore, operating at a plantation and sugar house almost on the site of Audubon Park in that city, succeeded in demonstrating the practicability of the production of cane sugar upon a commercial scale. This was virtually the beginning of the cane sugar industry in Lousiana, and the successful termination of the experiments of de Bore marked an important epoch in the development of the industrial and agricultural activity of that rich commonwealth.

Soon after the introduction of the sugar cane plant into Louisiana, it is claimed that cane culture was commenced upon a small scale on the East Florida coast and later along the Georgia coast south of Savannah, sugar-making upon a not inconsiderable scale for that period being carried on in the latter state during the early part of the last century. As to whether sugar cane was brought from Louisiana to this state or carried west to Alabama from the Georgia coast, is a question whose solution I have been unable to accomplish, and it is even possible that it might have been introduced direct from some of the West Indian islands.

Suffice it to say, sugar cane culture has been carried on in Southern and Middle Alabama upon a small scale at least almost from the date of the admission of the state into the Union, and while this cane has been grown chiefly for use in the production of syrup, nevertheless, in years gone by, crude and low grade sugar was produced in small quantities upon many plantations by processes still more crude.

As is well known to those residing in Middle and Southern Alabama, nearly all of the villages and towns of those sections of the state are supplied with home made cane syrup during the fall and winter months, and there has been a steady increase in the production of domestic syrup for a number of years past, although during the remainder of the year the local product does not meet the requirements of the local consumption.

The cane syrup production of this State in the last census year, according to the figures given in the twelfth census reports, was much larger than many of our own people would imagine, aggregating a total of 2,672,438 gallons of syrup upon 32,871 acres, although no allowance was made for the acreage of cane reserved for planting. The value assigned this product was $1,003,922, and though no information is given with regard to the marketing of this syrup there is no little doubt but that domestic consumption absorbed practically the whole output at that time.

The writer has called attention in a number of papers to the fact that at certain seasons of the year even in our local markets, it is well nigh impossible to secure pure cane syrups and the demand is largely supplied by syrup from outside markets.

These imported syrups are often adulterated with corn glucose, or else are the product of reboiling syrups and molasses which have undergone partial fermentation, while in still other cases it has been found that the syrups consist in part of low grade or dark colored molasses or syrups which have been bleached or brightened by treatment with

such chemical agents as bi-sulphite of soda and pulverized zinc.

It is gratifying to note, however, that within the past two or three years there has been a marked increase in the production and consumption of the domestic article in this State, and already some little attention is being given to securing outside markets for a portion of the yearly output of cane syrup. There has also been a noteworthy increase in the number of syrup producers, and some of these newest accessions to the ranks of producers are among the most progressive in the employment of rational and improved methods of cultivation and fertilization, as well as in the utilization of advanced and intelligent methods of manufacture.

In some of the border counties of South Alabama where a few years since cane patches of only from one to five acres were to be found, there can now be seen tracts of from twenty-five to fifty acres in cane, some of which vies in luxuriance and rankness of growth with the cane grown on the rich alluvial lands of Louisiana, while the sugar content is as a rule well in excess of that of the average Louisiana product.

In a previous bulletin the writer stated that as a result of observations and investigations made by him during a residence of several years in the sugar regions of Louisiana the conclusion was reached that the lighter and more easily drained uplands in the lower Mississippi valley yielded from season to season a cane much richer in sugar and total solid matters than the rich alluvial lands of the valley, although a much heavier tonnage was produced on the latter.

The results of experiments and investigations extending throughout a still longer period in this state have shown that the cane grown on the light loamy and sandy lands in the Southern part of this state exhibits a like superiority over the product of the heavy bottom lands of Louisiana, while a good tonnage can be readily secured where a judic-

ious system of fertilization is resorted to.

Much of the South Alabama cane will show a cane sugar content of 15 per cent. and upwards, while samples containing more than 18 per cent. sucrose have been analyzed in the laboratory at Auburn. The co-efficient of purity of the juices is also almost uniformly high, and with a high content of total solids the yield of syrup per ton of cane is correspondingly large.

The following analysis of three samples of cane selected at random while on a visit to Baldwin county may serve to illustrate the excellence of much of the cane grown in that section of the State.

	Sample No. 1	Sample No. 2	Sample No. 3
Total solids	19.3	19.2	19.0
Sucrose	17.0	15.1	16.9
Reducing sugars	1.31	1.92	1.15
Solids not sugars	.99	2.18	.95
Co-efficient of purity	88.1	78.7	88.9

When the fact is noted that much of the Louisiana cane does not show a total solid content in the juice of more than 14 per cent. and a cane sugar content frequently not exceeding 12 per cent., the good quality of such canes as the above is rendered more apparent, and as the syrup producing capacity of a cane is practically in direct proportion to the amount of total solids in the juice, the superiority of these canes for syrup making is at once evident.

Notwithstanding the fact that cane of such high sugar content can be produced upon many of the soils of Middle and Southern Alabama, it must be admitted that prior to the last three or four years the syrup industry had made but little progress from year to year and the production of this commodity commercially had not attained very large proportions.

Among the causes and conditions that have so far contributed to the slow progress and growth of the syrup in-

dustry may be mentioned; the employment of crude and unprogressive methods in the manufacture of the syrup from the cane; the production of syrup of poor keeping quality and lacking in uniformity of composition, character and flavor, and, finally, the failure to build up a market for the product, by reason of the uncertainty of its quality and of its variable composition.

In most cases throughout the cane growing region of Alabama, small bottoms are selected for the growing of cane, and, too often, comparatively little attention is paid to fertilization. The crop is grown for several successive years upon the same plot and when the land commences to fall off in productiveness the cane patch is transferred to another bottom which, in turn, becomes the seat of cane growing operations for a number of years, to be later abandoned like its predecessor, when the limit of its producing capacity has been reached.

Fortunately, some of the more intelligent and progressive cane growers in the southern portion of Alabama have demonstrated that the flat, slightly elevated, sandy uplands, with a clay sub-soil can, with proper cultivation and fertilization, be made to produce crops of large tonnage, accompanied by a high sugar content. In that section the best results have been secured by the growing of preparatory green crops, such as cow peas, or velvet beans, which supply the soil with a good proportion of humus forming material and nitrogen, together with no inconsiderable amounts of phosphoric acid and potash brought up from the lower soil. These fertilizing materials furnish nutrition to the cane crop which is to follow, while the humus which has been added to the soil makes the latter more retentive of moisture and better enables it to withstand the droughts which may come sooner or later during the cane growing season. This preliminary treatment of the soil to be devoted to cane culture is followed up by heavy applications of a mixed fertilizer furnishing a moderate supply of phos-

phoric acid and relatively large proportions of nitrogen and potash.

A number of years ago the writer conducted a series of investigations with regard to the composition of the cane plant at different stages of growth, and also made complete analyses of the fully matured plant, including both tops, or blades, and stalks. As a result of these experiments it was ascertained that a crop of twenty tons per acre required for its production 68 pounds of nitrogen, 44 pounds of potash and 30 pounds of phosphoric acid. As the juice from the cane contains only a very small amount of these constituents, it would seem that nearly the whole amount of these materials could be restored to the soil by turning under the bagasse from the cane mill, as well as the leaves stripped from the cane, but in practice the disintegration and the incorporation of the tough and fibrous bagasse in the soil is found to be an extremely difficult problem and in Louisiana this material is used as fuel under the sugar house boilers, while the cane leaves are burned in the field with a view to checking or preventing the ravages of the cane borer.

A glance at the proportions in which these elements occur in the cane will show at once that the cane plant has a strong predilection for nitrogen, and will enable one better to understand the good results secured from the growing of cane upon lands containing abundant natural supplies of this valuable element, or upon which liberal applications of nitrogenous manures have been made.

If the employment of progressive and rational methods is necessary in the cultivation and fertilization of the crop, the use of intelligence and skill in the manufacture of the syrup is doubly essential. Indeed, it is quite surprising that the industry in some portions of this and of the adjacent States has been conducted with any profit, whatever, in view of the crude and uneconomic methods which have obtained to a greater or less extent in the manufacture of

this commodity.

In the first place the extraction of the juice from the cane is often effected most imperfectly, and even where a mill is normally capable of extracting 65 of the 90 per cent. of the juice contained in the cane, its maximum efficiency is seldom realized for the reason that the rolls are not screwed up tightly for fear that the feeding of the mill will be rendered more difficult. On this account, many mills only give an extraction of from 55 to 60 per cent., leaving from 30 to 35 per cent. in the half crushed cane, and, even where the maximum extractive capacity of the average three roller horse mill is attained, there is still a very heavy loss sustained by reason of the unexpressed juice left in the bagasse.

As an illustration of the advantage of the employment of a modern mill of high extractive power, it might be stated that Mr. E. Smith, of Fairhope, Ala., one of the most successful syrup producers in the State, was able to secure as high an extraction as nearly 75 per cent. of juice by the use of a five roller mill purchased by him from George L. Squiers & CO., Buffalo, New York. This mill consisted of two crusher rollers together with a three roller mill of the usual type, and by its employment the yield of juice from the cane was increased more than one fourth. A mill of similar construction is in operation at the plant of the Southern States Lumber Co., at Magnolia Hill plantation, in Baldwin county.

The question of the satisfactory extraction of the juice having been solved, the next problem which presents itself is the proper clarification and evaporation of the juice, and it is in this part of the process that our present or commonly followed methods of procedure have proved most unsatisfactory and unscientific.

The removal of mechanical impurities is often effected by passing the juice through an old burlap bag, while the clarification and evaporation are conducted in a single wooden-frame evaporater, the bottom of which is covered with sheet

copper or galvanized iron, while transverse partitions, supplied with gates or openings, are designed to regulate the flow of juice or of partially cooked syrup from one end of the evaporater to the other.

As a rule, no clarifying agents are employed, and the juice running in at one end of the evaporator is hastily brought to a boil, hurriedly skimmed, and, before full opportunity has been had for the formation or removal of the blanket of impurities, the liquid is pushed rapidly along from compartment to compartment, the impurities in solution and those still left in suspension being rapidly cooked down with the syrup, giving a product dark in color, lacking in delicacy of flavor, and more readily susceptible to fermentation by reason of the presence of an undue proportion of albuminoids and other organic impurities.

As the finished product is commonly allowed to flow out in a slow, continuous stream, with no means of determining its density except by the application of the "rule of thumb," the syrup is greatly lacking in uniformity of density and quality. If, on the one hand, the syrup boiler fails to cook the syrup to a proper density, fermentation is all the more likely to ensue, while if the desirable density is exceeded the product is sure to crystalize, or "sugar," sooner or later.

In addition to all of these defects and disadvantages of the ordinary evaporator, the regulation of the heat is quite a difficult matter. A slow fire will not permit the evaporation to keep pace with the mill, while a too rapid fire may scorch the syrup or cause loss by boiling over, the usual remedy being to rake out some of the fire, or else lift the evaporator off of the furnace, while operations are always resumed after some delay with the possibility or probability of the recurrence of the same trouble after a short interval.

In order to secure the best results in clarification and evaporation, the heat should be easily and quickly controlled, so that evaporation can be accelerated or retarded at

will, or, if necessary, suspended instantaneously. The employment of steam for heating purposes is the only sure means of attaining these ends, and while it may not be practicable to utilize the steam evaporator where only a crop of 200 or 300 gallons of syrup is produced, or where the only use of the boiler employed is in the working up of a small crop of cane, still, steam evaporation can be employed advantageously upon a comparatively small crop upon farms where a boiler and engine can be used to good purpose in other departments of the farm economy. With somewhat larger crops the employment of steam evaporation will be highly desirable without regard to any other possible use of the boiler and engine, as the superiority and uniformity in the quality of the product secured fully justifies the increased initial cost of the steam plant.

As regards the clarification of the juice, a number of different methods of procedure have been adopted in various portions of the cane producing belt of the Southern States and there is naturally some difference of opinion as to the relative merits of the several processes employed.

Where a syrup of higher grade and purity, as well as of a brighter color, is desired, sulphuring and liming of the juice is resorted to, and a much more thorough removal of impurities is affected by this process. With a juice slightly acid in its normal condition the acid reaction is largely increased as a result of the sulphuring process, and a portion of this acidity is overcome by the use of a high grade lime, slaked to a thin paste. Especial care must be taken to avoid the employment of an excess of lime, and the juice should be left distinctly acid to litmus test paper, as inversion, the "bete noir" of the sugar maker, should have no terror to the syrup producer, who should delight in the presence of a large proportion of non-crystalizable sugar in his syrup.

If an excess of lime has been inadvertently added, this excess can be easily removed by the use of a small amount of high grade "acid phosphate" of lime, such as is sold un-

der the trade name of "Clariphos." This latter agent is also employed as a clarifying agent instead of sulphur fumes, and bi-sulphite of lime is also employed to no little extent as a substitute for the sulphur and lime process of clarification.

With the simplest form of sulphuring apparatus ordinarily used in small syrup plants, the juice fresh from the mill is allowed to run slowly through a sulphuring box containing a number of inclined shelves, and, as the juice tricles slowly down from shelf to shelf, it meets with an ascending current of sulphur fumes, which are produced by burning brimstone or roll sulphur in a roughly constructed brick furnace. In this way the juice is at once rendered lighter in color and when heated in the evaporator, after careful liming, the separation of albuminous matters and other impurities is affected more readily and rapidly.

To show the adaptability of even crudely constructed steam evaporators to syrup making on a small scale, experiments have been conducted at the Alabama experiment station at intervals for a number of years with the employment of two small evaporators especially devised for experimental purposes, the smaller of the two being improvised from an ordinary open-fire evaporator already on hand.

The sides of the evaporators were of wood, as usual, and the bottoms were constructed of sheet copper, but no partitions were employed as in the ordinary evaporators. A series of pipes, connected at the end by return bends were placed in the bottom of each evaporator, almost the whole surface of the bottom being thus covered, with the exception of a space about four or five inches in width, which was reserved for the collection of the scums from the boiling juice. This unoccupied space should be on the side of the evaporator opposite to the point at which the steam is admitted, and this side should be slightly lower than the other in order to facilitate the removal of the scums. The piping employed was galvanized iron, from three-fourths to one inch inside

diameter, and valves were provided for the proper regulation of the steam used in the evaporation, while another set of valves enabled the operator to prevent the too rapid escape of waste steam from the coil.

The juice, after sulphuring, is run into the small evaporator or clarifier, milk of lime is added, and the contents of the evaporator brought gradually to a temperature slightly under the boiling point. The scums and impurities come to the surface quite rapidly, the greater portion of them collecting over the space not occupied by the pipes, where they can be easily removed.

The clarifier is somewhat more elevated than the evaporator, and when the juice has been well skimmed it is at once run into the large evaporator, and the steam is immediately turned on. Fresh quantities of the juice are now run into the clarifier, boiled, skimmed and then run into the evaporator, the evaporation of the juice being conducted all the while. Any scums which form in the evaporator can be removed in the usual way, and when the syrup has reached the proper density the steam is shut off and the evaporator is emptied through the usual outlet.

By the substitution of copper coils for the galvanized iron pipe, a very much greater evaporative effect can be secured from the same heating surface and from the same steam pressure—an advantage which will in most cases, outweigh the increased first cost of the evaporating apparatus.

Many of our cane planters and small syrup producers still persist in drawing off the syrup at random, and without reference to its density, notwithstanding the fact that the Beaume hydrometer or saccharometer can be employed to good advantage in determining the point at which the syrup becomes sufficiently dense to be drawn off, and when the spindle immersed in the hot liquid reads 33 to 34 degrees the liquid can then be run out of the evaporator. Farmers in Alabama who have used the Beaume spindle report good

results from its employment, and state that by means of its use no difficulty is experienced in boiling the syrup to a uniform density.

While the flavor of a syrup is a prime consideration in the production of marketable article, the relative clearness and color of the product is an important factor in determining the price it will bring upon the market, and this fact should not be lost sight of in the clarification and defecation of the juice and syrup, though it also must be borne in mind that the employment of undue proportions of clarifying agents is liable to affect the flavor or taste to an objectionable extent.

Whether the syrup is to be marketed in barrels, cans or bottles, the receptacles in which the product is put up should be well cleaned and thoroughly scalded out or steamed and every precaution taken to exclude ferments from contact with the contents of the vessels.

As is well known, a large part if the cane syrup found on the markets after the first warm weather of the spring sets in is that which has been put up in sealed cans or bottles, and almost invariably in the former. Moreover, a syrup put up hot in a clean vessel, and securely sealed while still hot, may be preserved almost indefinitely without danger of fermentation or of crystilization of sugar.

Samples of syrup in sealed jars or bottles have been preserved at the laboratory of the Alabama Polytechnic Institute for from four to five years without any indication whatever of fermentation or separation of sugar being observed, and analyses of the syrups before and after the completion of the period of the tests, showed no appreciable variations in the composition of the article.

With the exercise of proper care in the clarification and preservation of the genuine cane syrup, the imported, or at least the adulterated article, should soon be excluded from the market, and the consumer can then be assured of the purity and good quality of the goods which he purchases.

Moreover, when it is once known that syrup of good quality and high purity and possessing the fresh taste of the original article, can be obtained in any month in the year, it will be quite easy to build up a market for such goods and the home demand will necessitate an increase in the supply of the home manufactured product, while outside markets will readily take care of the surplus production of an article whose reputation for purity and excellence of quality has become well established.

EXPERIMENTS IN SYRUP MAKING.

In addition to experiments described in previous bulletins (Nos. 66 and 103,) a large amount of experimental work in methods of syrup making has been done both at the Station and at various syrup plants in the Southern part of the State, facilities for this work having been afforded at Mr. E. Smith's place, near Fairhope, and at the syrup plant of the Southern Industrial Association near Gateswood, Ala., while visits were paid to a number of other plants during the syrup making season.

Extraction of Juice.

A number of extraction tests were made at various steam and horse mills, and it was found that in most cases the proportion of juice extracted by the two roller and three roller mills ranged from 55 to 60 per cent. The highest extraction noted was that secured upon the five roller mill of Mr. E. Smith, to which previous reference was made, and upon some trial runs approximately 75 per cent. extraction of juice was obtained. When the fact is noted that the employment of one of the poorer grades of mills would involve a loss equivalent to five tons of cane per acre upon a crop of twenty tons per acre, the importance of securing a good yield of juice should be readily recognized.

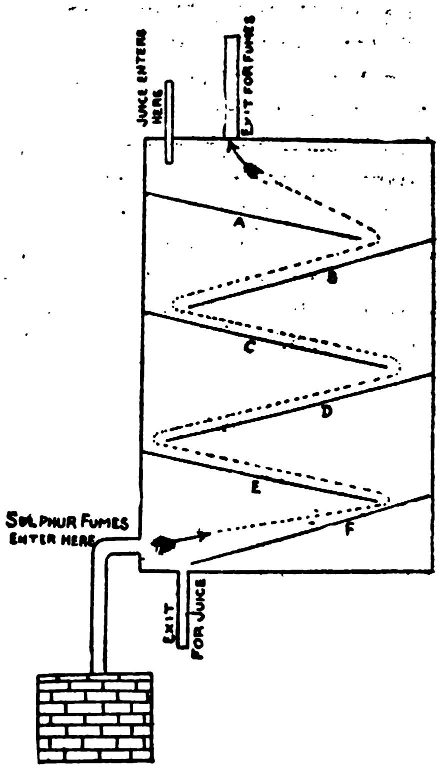
Defecation or Clarification of Juice.

Allusion has been previously made to the common employ-

ment of burlap strainers for filtering the juice as it comes from the mill, but a strainer of fine sheet metal gauze can be used to much better advantage and can be easily kept clean. This gauze is, of course, chiefly of value in removing particles of trash, small fragments of bagasse, etc.

At some syrup plants in the southern part of the State it was noted that the juice from the mill was conducted through filters of Spanish moss, but so far as the observation of the writer has extended, the utility of this material is solely dependent upon the removal by it of mechanically suspended impurities which are found in the juice.

In bulletin No. 66, a form of sulphuring apparatus which has been much employed in Louisiana was described in detail and illustrated by a cut, this apparatus being constructed substantially as described on a preceeding page in this bulletin. For the information of the readers of the present bulletin this cut is reproduced herewith.



This sulphuring box has been used to good advantage at the Experiment Station and upon some nearby farms, but as some syrup producers have experienced trouble in constructing this particular form of apparatus, it was deemed desirable to devise a somewhat simpler appliance for use in sulphuring juices, and it was soon found that a satisfactory apparatus could be improvised from a large syrup barrel of 50 or 60 gallons capacity.

Several of the upper hoops of the barrel were removed and the head was carefully taken out, in order that a couple of false bottoms might be inserted in the barrel at about one-third and two-thirds of its height, these false bottoms

being held in position by small cleats nailed to the sides of the barrel. A half inch pipe was inserted in the bottom of the barrel to provide for the outflow of juice, while a two inch pipe passing through the side of the barrel about three inches above the bottom was used to convey the sulphur fumes from the small sulphur furnace. A pipe of like dimensions fastened through the top of the barrel was employed as an exit for the fumes, while numerous perforations in the top provided for the inflow of the juice.

Straw was loosely packed between the bottom, the false bottoms and the top of the barrel, before replacing the top, this material being used to cause the juice to break up into a number of fine streams in order that it might expose a larger surface and absorb the sulphur fumes more readily. It was found that instead of perforated false bottoms a framework of small strips could be used to good advantage as a support for the straw.

The sulphur furnace to be employed in connection with the above described sulphuring apparatus can be contstructed of a few brick or else a small box of sheet iron can be used. A cone of thick sheet asbestos, with the apex of the cone inserted in the end of the pipe designed to convey the fumes can also be used as a furnace in case a large volume of fumes is not required. Brimstone or roll sulphur is the form of sulphur employed and is burned in a small iron dish or in the inverted top of a tin can, comparatively free access of air being permitted.

It is desirable that the barrel be well filled with fumes before the juice is allowed to run through it and it will be noted that the escaping juice is much brighter in color, while it has been found that in many cases a sufficient absorption of sulphurous acid is affected to admit of the sulphured juice being mixed with an equal volume of the raw juice.

This department has also found that it is possible to employ liquified sulphurous acid in the sulphuring of juice, this product being obtained by condensing sulphur fumes under

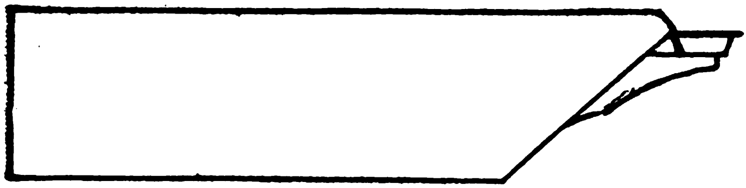
pressure in steel cylinders. A valve is attached to the cylinder and upon opening it shightly a flow of gas takes place, it being possible to conduct this gas through a tube to the bottom of a tall juice vat and as the gas bubbles up through the liquid it will sulphur it quite thoroughly. When purchased in small quantities the liquid sulphurous acid is somewhat expensive for use as a clarifying agent, but if a considerable demand for it were created in a given section, it could no doubt be secured at much lower figures.

If a settling tank is at hand the sulphured juice can be transferred directly thereto and within an hour or two it will be found that a considerable proportion of the impurities of the juice have separated from the main body of the liquid, rendering its subsequent clarification more easy.

The juice is next transferred to the clarifier or small evaporator previously described, and heated up slowly to the boiling point, milk of lime (in the form of a whitewash, free from lumps,) being added until the juice is left only slightly acid as indicated by litmus test paper. The juice is then brought to a brisk boil, so that the blanket or coating of scums rises and shows a number of cracks and seams on its surface, after which the heat is partly cut off and the scums are removed.

A deep form of clarifier is more effective than a shallow one and as before suggested it is desirable that a space unoccupied by the coil of steam pipe be left either at the side or end of the clarifiers and evaporators. It will also be found advantageous to have one end of the clarifier inclined at an angle of about 40 or 45 degrees to the horizontal, the scum trough being attached to the inclined end of the evaporator.

The following cut shows the side elevation of such a clarifier and also the position of the scum trough.



SIDE ELEVATION OF CLARIFIER.

In a clarifier of this character the scums can be pushed along easily by a broad wooden skimmer from one end of the vat to the other, being easily brushed over the inclined end of the clarifier into the scum trough.

Although the use of lime as a clarifying agent is recommended in connection with the employment of sulphur, it is quite possible to secure good results from the use of sulphur, even where lime is omitted, though the sulphur fumes in the absence of lime would give the juice quite a perceptibly acid re-action. Instead of the employment of sulphur fumes for brightening or bleaching the juice, bi-sulphite of lime may be used in the proportion of one quart to 50 gallons of juice, although it does not usually yield quite so bright a syrup as does the juice treated with sulphur fumes. This chemical can be purchased from I. L. Lyons & Co., New Orleans, La., and is prepared by the action of sulphurous acid or sulphur fumes upon milk of lime.

In conjunction with sulphur, or in the entire absence of sulphur, acid phosphate of lime may be used as a clarifying agent and in many cases with most excellent results.

The preparation of acid phosphate used by this department was sold under the trade name of "Clariphos," and was purchased from J. Watts Kearny & Sons., New Orleans. This is simply a strong solution of acid phosphate of lime, which is free from any objectionable impurities and has been prepared especially for use as a clarifying agent in sugar factories.

Prior to the application of this agent the juice must be treated with lime until the original acidity of the juice has

been neutralized and the manufacturers of this preparation even recommended that lime be added in slight excess, or until red litmus test paper changes to a slight blue. At this point the clariphos is added in the proportion of one half gallon to 1000 gallons of juice it being diluted somewhat with water before adding it. Experiments made by the writer indicate that for syrup making it may be used advantageously in as large a proportion as one gallon of clariphos to 1000 gallons of juice.

After addition of this agent, the juice is boiled gently for a moment or two, the heat is turned off and the juice allowed to settle in the clarifier, or else it is run off in a settling tank. The lime which was added previous to the clariphos combines with the free acid of the latter, forming a bulky precipitate which settles rapidly, carrying down with it a large amount of organic impurities and suspended matter and leaving a clear, bright juice, which can easily be drawn off from the sediment. In this connection, it must be noted that the juice should be thoroughly skimmed or brushed after the addition of the lime and before the addition of the "Clariphos," and especial care should be taken to see that the milk of lime is free from lumps or granular particles.

Where agents other than clariphos are employed in clarification and in case considerable suspended matter is still present in the clarified juice, bag filters may be used to some advantage in the removal of much of this suspended matter.

The form of bag filter best adapted to this purpose is a long slender bag of closely woven texture which is supported by an outer bag of coarse netting, the two being suspended from the top of a tall wooden box or chamber which can be closed tightly, so that the interior of the compartment may be well heated by a jet of steam. The juice is allowed to enter the filter through an opening in the top of the chamber, and is drawn off from the bottom into a settling tank or into an evaporator.

By admitting steam to the filtering chamber, the filter and the juice being filtered are both kept hot and the filtration, in consequence, can be effected more rapidly.

This department is under obligations to Mr. West Livandais, New Orleans, La., for filter bags kindly donated for use in experiments conducted during the past season.

In case the syrup plant is supplied with a sufficient number of deep clarifiers, the juice may be advantageously evaporated down to semi-syrup in them before being transferred to the final evaporator or an intermediate evaporator may be employed between the clarifiers and the finishing pans. Where this plan is adopted, the semi-syrup is generally allowed to attain a density of from 20 to 25 degrees Beaume, hot, before being transferred to the last evaporator of the series.

Experiments were made during the past season in connection with the employment of sand filters for the removal of suspended matters from the semi-syrup, and where sand of pure quality was employed, some fairly good results were secured.

It was found necessary to wash even the best sand for some little time in order to remove clay and finely divided matter, whose presence rendered the wash water turbid, and when the sand finally permitted the water to pass through clear, it was found that the syrup would also pass through the sand filter comparatively clear and practically free from suspended matter. The sand filter was arranged by employing a tray or shallow box, the bottom of which was constructed of coarse wire gauze, covered by a coarse cloth, upon which a layer of sand of one and a half to two inches thick was placed.

Unless very pure sand, requiring very little washing be used, the employment of sand filters may be found troublesome, however, and the sand will, of course, have to be renewed frequently. Filters of this kind, nevertheless, would serve quite a good purpose in case some special lot of semi-

syrup contained an excessive amount of suspended matter, which previous treatment in the defecators had failed to remove.

The concentration of the syrup in the final evaporators is continued until the Beaume hydrometer registers about 34 degrees in the hot syrup, and where there is only a thin layer of syrup left in the evaporator, it may be advisable to shut off steam when the instrument registers 33 and one half degrees, as the hot syrup in contact with the hot pipes which may still contain a little steam, will probably evaporate a little further before it can be drawn off.

For the removal of finely divided suspended particles from the hot syrup, the employment of cotton batting which was suggested and tried last season by Mr. A. F. Cory, at the syrup plant of the Southern Industrial Association, Gateswood, Ala., appears to be quite advantageous and good results were secured both by Mr. Cory and also by the writer in some experiments conducted at Auburn. The kind of cotton batting employed in the syrup filters was the same as that used by the turpentine distillers, one surface of the goods being glazed, while the other surface was rough. The batting was placed upon coarse wire gauze in a shallow box or tray and the syrup was allowed to flow on the filter in such a way as to obviate the possibility of washing a hole through the cotton filter, the liquid being diffused over the whole surface of the material.

Previous allusion has been made to the importance of thoroughly scalding out and steaming the containers in which the syrup is to be put up, and too much care and caution cannot be given to the matter of excluding ferments or bacteria from the packages if an article capable of long preservation is desired.

As regards the arrangement of the settling tanks, vats, clarifiers, evaporators, etc., in the syrup factory, the writer would say that the plan adopted by the Southern States Lumber Co. at their plant at Magnolia Hill plantation in

Baldwin county is a most excellent and convenient one. The juice from the mill is pumped to settling or storage tanks placed on the highest floor in the building, the juice from these tanks being allowed to flow by gravity to the clarifiers or defecators, of which there was one for each storage tank on the next lower floor. The juice or semi-syrup from the defecators was also conducted by gravity to settling tanks on the next lower level, and from there to the large evaporator or finishing pan on a still lower level.

The packing of the syrup was carried out on the ground floor of the plant, the natural slope of the ground having favored the arrangement of the interior of the establishment in the maner described—an arrangement which greatly facilitated the operations of the factory.

Small Central Syrup Plants.

Several years since the writer advocated the idea of the operation of small central syrup-making plants in connection with steam gins which are found occurring in such close proximity to each other throughout much of the cane growing territory in this State and practical demonstrations of the feasibility of the plan were made during the past two seasons. Since many of these neighborhood gins suspend operations before any destructive freezes occur, the motive and steam power of these establishments can be utilized to good advantage in making syrup.

During the present season an experiment along this line was made at the place of Mr. J. C. Moore, near Auburn, only a few hours being required to install the clarifiers and evaporators and to make the necessary connections with the boiler, while all the apparatus worked satisfactorily from the beginning of the experiments and quite a good article of syrup was produced.

As before stated, wherever a boiler of sufficient capacity is in use for ginning, milling or other purposes, it is quite a simple matter to instal a syrup making outfit, and where

new steam gins are established in cane growing regions, sufficient steam power can be provided to meet the combined requirements of a syrup plant and steam ginnery.

By the adoption of such a plan, small central syrup factories could easily be put in operation throughout a large portion of Southern and Middle Alabama, and the introduction of improved methods of manufacture would quickly follow upon the inauguration of such a system.

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

Corn Culture.

By

J. F. DUGGAR,

Director and Agriculturist.

Opelika, Ala.
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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

CORN CULTURE

By J. F. Duggar.

SUMMARY.

During the past ten years 52 varieties of corn have been tested at Auburn, Alabama. Among these the most productive varieties were Mosby, Cocke, Henry Grady and Sanders.

Varieties of the prolific type, "two-eared varieties," afforded larger average yields than did the type in which the number of ears was smaller but the size larger.

Early varieties were relatively unproductive.

Repeated tests of seed corn grown in different latitudes indicated that with certain varieties seed from Virginia and Tennessee proved superior to that from Delaware, Illinois, Alabama and Georgia. It is impossible to determine whether this result was due chiefly to climate or to more careful selection of the seed corn obtained from Virginia and Tennessee. It is generally advisable that seed corn for Alabama be obtained either from this latitude or from some other region south of the Ohio and Potomac rivers.

Many early varieties from northern grown seed afforded a large proportion of unsound corn.

In six tests seed corn from the bottom ear afforded a slightly larger yield than from the top ear and in two tests seed from the top ear gave the larger yield.

Subsoiling did not increase the yield of corn sufficiently to be profitable.

The yield was not materially influenced by the depth of the first cultivation.

Planting corn in water furrows did not increase the yield.

The yield of grain was slightly decreased by pulling fodder, by topping and by cutting and shocking the plant. The average yield of dry fodder or blades was 515 pounds of

cured tops 473 pounds and of cured stover 1,799 pounds per acre.

The increase in the yield of corn due to the use of velvet bean stubble as a fertilizer was 4.3 bushels per acre. Where the entire growth of velvet beans was plowed under the increase in the first corn crop was 12.3 bushels and the increase in the second corn crop was 4.4 bushels. The increase in the two corn crops was 16.7 bushels greater where the entire growth of velvet beans was plowed under than where only the roots and stubble were plowed under.

The yield of corn was 8.9 bushels per acre greater when cow pea vines were plowed under than when only the stubble was used as fertilizer. The increase from plowing under beggar weed, which grew after the corn was laid by, averaged 5.4 bushels per acre.

When velvet bean vines or cow pea vines were plowed under the addition of acid phosphate profitably increased the yield of corn.

Applying a part of the fertilizer before planting and a part at the second cultivation did not increase the yield as compared with using all of it before planting.

Nitrate of soda afforded a larger increase than did cotton seed meal, cotton seed or barnyard manure.

It is recommended that a fertilizer for corn contain a relatively large proportion of nitrogen.

TESTS OF VARIETIES OF CORN IN 1901, 1904 AND 1905.

For ten years in succession tests of varieties of corn have been made on the Experiment Station farm at Auburn under the present management.

Bulletins Number 76, 88 and 111 of this Station, now out of print, give the results of variety tests at Auburn from 1896 to 1900 inclusive. In 1902 an unprecedented drought, from April to August, ruined our variety test, and in 1903 rogues vitiated the results. The results obtained in 1901, 1904 and 1905 are presented in this bulletin.

All of our tests were made on upland soil characteristic of this region, and naturally poor. Only commercial fertilizers were employed, except in 1905, when in addition to commercial fertilizers, barnyard manure, chiefly from cattle, was used at the estimated rate of ten tons per acre.

Planting was done at the usual time or a few days later and the distance between rows was usually 4 feet 8 inches, and between plants about three feet. The distance between plants was the same for all varieties.

Every precaution was taken to secure and maintain a stand, but when this was impaired by bud worms, no correction of yields was attempted.

Yield of varieties of corn in 1901.

Variety	Per ct. of stand	Yield per acre	Rank in yield
	Per ct.	Bus.	
Mosby	93	35 2	1
Shaw	91	31.9	2
Cocke	100	31 8	3
Arnold's Cross Bred	100	30 1	4
Tennessee White	91	29 9	5
Tennessee Yellow	100	28 8	6
Red Cob, Tennessee	93	27 7	7
Experiment Station Yellow	98	27.1	8
Blount	95	21 6	9
Jones Pearl	99	19 6	10
Hickory King	100	18.9	11

Yield of varieties of corn in 1904.

Variety	Per ct. of stand	Yield per acre	Rank in yield
	Per ct.	Bus.	
Sanders	88	**35.5**	1
Mosby	100	**35.5**	2
Cocke	91	**33.5**	3
Henry Grady	93	32.3	4
Cocke (Ga.)	96	29.6	5
McMackin's Gourd Seed	95	29.6	6
Experiment Station Yellow	100	26.8	7
Boone County White (Tenn.)	87	25.8	8
Boone County White (Ind.)	92	24.2	9
Boone County Special	88	23.5	10
Reid's Yellow Dent	92	22.1	11
Riley's Favorite	91	19.6	12
No. 77 U. S. Dept. Agr.	91	19.4	13
Silver Mine (Iowa)	81	19.1	14
Leaming Yellow	94	18.2	15
Snow Flake	81	12.9	16

Yield of varieties of corn in 1905.

Variety	Per ct. of stand	Yield per acre	Rank in yield
	Per ct.	Bus.	
Henry Grady	97	**40.6**	1
Sanders	99	**39.4**	2
Mosby	99	**38.9**	3
Marlboro	97	34.9	4
Local White Cob	91	34.3	5
McMackin's Gourd Seed	95	33.1	6
No. 77 U. S. Dept. Agr.	99	32.6	7
Cocke (Tenn.)	92	30.9	8
Experiment Station Yellow	96	30.7	9
Albemarle	81	30.3	10
Shaw	81	29.7	11
Boone County Special	94	29.4	12
Red Cob (Tenn.)	84	28.9	13
Cocke (Ala. Exp't Sta.)	92	28.6	14
Hickory King	96	28	15
Boone County White (Tenn.)	88	26.3	16
Reid's Yellow Dent	85	25.7	17
Boone County White (Ind.)	87	24.6	18
Boone County White (Ill.)	76	22	19
Silver Mine (Iowa)	93	22	20
Leaming Yellow	94	18.9	21
Riley's Favorite	80	17.1	22

Relative yield of varieties of corn at Auburn, taking the yield of Experiment Station Yellow as 100.

	1896	1897	1898	1899	1900	1901	1904	1905	Average
Tested 8 years									
Mosby	91	138	109	92	115	130	132	130	117
Exp't Sta. Yellow	100	100	100	100	100	100	100	100	100
Tested 7 years									
Hickory King	122	72	73	73	80	70		91	83
Tested 6 years									
Cocke		129	87		108	117	118	97	109
Shaw		99	117	81	95	118		97	101
Blount	132	103	72	83	98	80			95
Tested 5 years									
St. Charles	148	90	104	81	96				105
Tested 4 years									
Red Cob (Tenn.)				82	99	102		96	95
Jones Pearl	99	97		93		72			90
Champion White Pearl	126	79		74	70				87
Tested 3 years									
Sanders					104		132	128	121
Farmer's Pride		101	94		96				97
Early Mastodon	134	60			91				95
Iowa Silver Mine		48					71	72	64
Leaming Yellow					57		55	61	58
Tested 2 years									
Henry Grady							121	132	127
Arnold					113	112			112
McMakin's Gourd Seed							110	108	109
Renfro	86	128							107
Higgins	72	134							103
Boone County Special							88	96	92
No. 77 U. S. Dept. Agr							73	106	90
Boone County White							93	79	86
Golden Beauty			89		83				86
Evans				86	81				84
Reid's Yellow Dent							82	84	83
Riley's Favorite							73	56	65
Tested 1 year									
Golden Giant	125								125
Cade Prolific		124							124
Yellow Dent	117								117
Marlboro								114	114
Baden			113						113
Local White Cob								112	112
Bradbury					112				112
Tennessee White						110			110
Peabody	108								108
Tennessee Yellow						106			106
Albemarle								99	99
Cary Klondike					97				97
Strawberry		97							97
Giant Broad Grain					94				94
Chester County Mammoth	93								93
Golden Dent				92					92
Poor Man					89				89
Welborn's Conscience		87							87
Cuban Giant			79						79
Sheep Tooth White					75				75
Creole					74				74
Snow Flake							48		48

Mosby is one of the most productive of the prolific varieties. Comparing its record with that of other prolific varieties we find that in each of six years Mosby yielded more than Cocke; in comparison with Blount, Mosby led in five out of six tests.

Comparing Mosby with some of the most productive non-prolific varieties, we find that it stood ahead of Sanders in 2 out of 3 tests, and equaled Sanders in the third test; once Mosby stood above Henry Grady and once slightly below. Compared with Shaw, Mosby was the more productive in 5 out of 6 tests.

Compared with all varieties tested, Mosby occupied *first* place in 2 tests, *second* place in 2 tests, *third* place in 2 tests, *fourth* place in 1 test and *twelfth* place in 1896, when weather conditions injured all late varieties.

Cocke, though averaging less than Mosby, proved to be one of the most productive varieties when all of our tests, made during the last ten years are considered.

In six tests its relative position was *second* in 2 tests, *fourth* in 2 tests, and *seventh* and *tenth* in the other two years.

Henry Grady has been tested only two years, but has taken high rank, namely *first* in 1905 and *third* in 1904.

Sanders has been tested only two years, but in both has taken high rank. It was *first* in 1904 (equaling Mosby), and *third* in 1905.

Other promising varieties as regards yield, but which have not been often tested here, are: Bradberry, Marlboro, Arnold, Local White Cob, Tennessee White and McMackin's Gourd Seed.

For illustrations of ears of certain varieties, see Appendix.

RELATION OF NUMBER OF EARS PER PLANT TO YIELD OF GRAIN PER ACRE.

The following table gives the number of ears and nubbins of each variety per plant. It will be noted that even most

of the prolific varieties average less than two ears and nubbins per plant and that several varieties average less than one grain-bearing shoot per plant.

The number of grain-bearing shoots varies greatly for the same variety in different seasons, but, nevertheless, this number is largely a variety characteristic.

Number of ears and nubbins per plant.

Variety	1900		1901		1904		1905		
	Number	Rank	Number	Rank	Number	Rank	Number	Rank	Average
Albemarle	....	....	....	....	....	....	2.02	1	2.02
Arnold	.91	22	.94	10	....	....	....	....	.93
Blount	1.86	1	1.00	9	....	....	....	....	1.43
Boone County White	....	....	....	....	1.11	5	....	....	1.11
Bradbury	1.40	4	....	....	....	....	....	....	1.40
Cary Klondike	1.00	16	....	....	....	....	....	....	1.00
Champion White Pearl	.99	17	....	....	....	....	....	....	.99
Cocke	1.55	2	1.85	1	1.49	2	1.60	6	1.65
Creole	1.39	5	....	....	....	....	....	....	1.39
Early Mastodon	1.04	10	....	....	....	....	....	....	1.04
Evans	.92	21	....	....	....	....	....	....	.92
Experiment Sta. Yellow	1.17	7	1.36	3	....	....	1.44	7	1.32
Farmers' Pride	.99	17	....	....	....	....	....	....	.99
Giant Broad Grain	1.03	12	....	....	....	....	....	....	1.03
Golden Beauty	1.03	12	....	....	....	....	....	....	1.03
Henry Grady	....	....	....	....	1.15	4	1.37	9	1.25
Hickory King	1.31	6	.91	11	....	....	1.38	8	1.20
Jones' Pearl	....	....	1.18	5	....	....	....	....	1.18
Leaming	.99	17	....	....	.77	11	....	....	.88
Local White Cob	....	....	....	....	....	....	1.10	14	1.10
Marlboro	....	....	....	....	....	....	1.86	2	1.86
McMackin's Gourd Seed	....	....	....	....	1.11	5	1.21	12	1.16
Mosby	1.02	14	1.60	2	1.36	3	1.74	3	1.43
No. 77 U. S. Dept. Agri.	....	....	....	....	.85	9	1.24	11	1.05
Poor Man	1.15	8	....	....	....	....	....	....	1.15
Red Cob, Tenn.	1.01	15	1.04	8	....	....	1.15	13	1.07
Reid's Yellow Dent	....	....	....	....	1.05	7	1.68	5	1.37
Riley's Favorite	....	....	....	....	.98	8	1.08	15	1.03
Sanders	1.45	3	....	....	1.61	1	1.74	3	1.60
Shaw	.96	20	1.12	7	....	....	1.27	10	1.12
Sheep Tooth, White	1.04	10	....	....	....	....	....	....	1.04
Silver Mine, Iowa	....	....	....	....	.85	9	.99	16	.92
St. Charles	1.12	9	....	....	....	....	....	....	1.12
Tennessee White	....	....	1.22	4	....	....	....	....	1.22
Tennessee Yellow	....	....	1.16	6	....	....	....	....	1.16

Dividing the varieties tested according to number of ears and nubbins per plant, we have the following classification:

Prolific varieties.

Sanders	Albemarle
Blount	Marlboro
Mosby	Cocke

Medium prolific varieties.

Hickory King	Creole
Jones' Pearl	Reid's Yellow Dent
McMackin's Gourd Seed	Experiment Sta. Yellow
Tennessee Yellow	Henry Grady
Poor Man	Tennessee White
Bradbury	

Non-prolific varieties.

Golden Beauty	Shaw
Riley's Favorite	St. Charles
Cary Klondike	Boone County White
Farmers' Pride	Local White Cob
Champion White Pearl	Tennessee Red Cob
Arnold	No. 77, U. S. Dept. Agr.
Silver Mine, Iowa	Early Mastodon
Evans	Sheep Tooth White
Leaming Yellow	Giant Broad Grain

The above classification has been made as a means of securing an answer to the question, "What type of corn has been most productive in recent tests at the Alabama Experiment Station?" An examination of the yields gives the following table of averages:

Average yields of types of corn in bushels per acre.

	Prolific.	Medium.	Non-prolific.
	Bus.	*Bus.*	*Bus.*
1900—Average yield	37.4	27.8	31.6
1901—Average yield	29.5	24.7	29.9
1904—Average yield	34.2	26.6	20.2
1905—Average yield	34.0	31.6	26.5
4 years, average of averages	33.8	27.7	27.0

In three out of four years the prolific varieties gave decidedly the highest average yield. It must be stated, however, that the averages for the medium and non-prolific varieties are low largely because these lists embrace so many early non-productive northern varieties.

In the following table all early or otherwise unproductive varieties have been eliminated and a comparison made between the average yields of the best prolific, the best medium and the best non-prolific varieties.

Average yields of best varieties of three types.

Year	Prolific Vars.		Medium Vars.		Non-Prolific Vars	
	Bus.		Bus.		Bus.	
1900	39.	Mosby Cocke	37.	Bradbury Expt. St. Yel.	35.9	Shaw Red Cob Arnold
1901	33.5	Mosby Cocke	28.6	Expt. St. Yel. Tenn. White Tenn. Yel.	29.9	Shaw Red Cob Arnold
1904	34.2	Mosby Cocke Sanders	29.6	Expt. St. Yel. Henry Grady McMackin		
1905	36.9	Mosby Cocke Sanders Albemarle Marlboro	34.5	Expt. St. Yel. Henry Grady McMackin	31.6	Local Wh. Cob Red Cob
Av.	35.9		32.4		32.4	

The above figures show that the best prolific varieties each year averaged higher than the best varieties bearing a smaller number of ears.

SIZE OF EAR IN DIFFERENT VARIETIES.

Number of ears and nubbins required to shell 56 pounds of grain.

Va	Variety	1900 Number	1900 Rank	1901 Number	1901 Rank	1904 Number	1904 Rank	1905 Number	1905 Rank	Average
	Albemarle	....	....	....	....	....	....	168	....	168
	Arnold	78	1	115	1	....	....	....	....	97
	Blount	151	22	161	7	....	....	....	....	156
56	Boone County White	....	....	....	....	141	5	....	....	141
	Bradbury	122	11	....	....	....	....	....	....	122
	Cary Klondike	99	4	....	....	....	....	....	....	99
	Champion White Pearl	139	18	....	....	....	....	....	....	139
62	Cocke	133	14	209	10	167	10	154	12	166
	Creole	172	23	....	....	....	....	....	....	172
	Early Mastodon	109	6	....	....	....	....	....	....	109
	Evans	111	8	....	....	....	....	....	....	111
	Experiment Sta. Yellow	120	10	161	7	....	....	130	7	137
	Farmers' Pride	99	4	....	....	....	....	....	....	99
	Giant Broad Grain	113	9	....	....	....	....	....	....	113
	Golden Beauty	123	12	....	....	....	....	....	....	123
	Henry Grady	....	....	....	....	126	1	101	2	114
60	Hickory King	149	21	184	9	....	....	148	11	160
	Jones' Pearl	....	....	220	11	....	....	....	....	220
59	Leaming	147	20	....	....	135	3	....	....	141
	Local White Cob	....	....	....	....	....	....	90	1	90
	Marlboro	....	....	....	....	....	....	161	14	161
57	McMackin's Gourd Seed	....	....	....	....	134	2	106	4	120
	Mosby	143	19	156	6	151	7	137	10	147
	No. 77 U. S. Dept. Agri.	....	....	....	....	159	8	117	6	138
	Poor Man	126	13	....	....	....	....	....	....	126
	Red Cob, Tenn.	93	3	137	4	....	....	102	3	111
47	Reid's Yellow Dent	....	....	....	....	165	9	172	15	169
	Riley's Favorite	....	....	....	....	171	11	157	13	164
	Sanders	136	17	....	....	145	6	135	9	140
	Shaw	97	2	121	2	....	....	108	5	109
	Sheep Tooth, White	135	15	....	....	....	....	....	....	135
	Silver Mine, Iowa	....	....	....	....	136	4	131	8	134
	St. Charles	109	6	....	....	....	....	....	....	109
	Tennessee White	....	....	136	3	....	....	....	....	136
	Tennessee Yellow	....	....	149	5	....	....	....	....	149

160 Iowa Gold Mine.
60 " Silver "

By means of this table we are able to make three groups of varieties according to the average size of ears and nubbins, that is according to the number of ears and nubbins required to shell one bushel of 56 pounds of grain.

A much better showing would, of course, be made for each variety if we should give a table showing the number of well grown ears required to shell a bushel. The figures in the above table are not intended to show the average weight of typical, well grown ears, but to indicate how many ears and nubbins a farmer must handle to obtain one bushel of grain. This, of course, varies widely with the season, as well as with the variety.

Large-eared varieties.

Arnold	Local White Cob
Cary Klondike	McMackin's Gourd Seed
Early Mastodon	Red Cob
Evans	Renfro
Farmers' Pride	Shaw
Giant Broad Grain	St. Charles
Henry Grady	Strawberry
Higgins	

Medium-eared varieties.

Bradberry	Poor Man's
Experiment Station Yellow	Sheep Tooth White
Golden Beauty	Silver Mine
Jones Pearl Prolific	Tennessee White
No. 77 U. S. Dept. Agr.	Welborn's Conscience

Small-eared varieties.

Champion White Pearl	Hickory King
Sanders	Marlboro
Leaming	Riley's Favorite
Boone County White	Cocke's Prolific
Mosby	Albemarle
Tennessee Yellow	Reid's Yellow Dent
Blount	Creole

EARLY AND LATE VARIETIES.

Grouping the varieties according to earliness when grown in the South, we have the following groups:

Early varieties.

Blount	Leaming
Boone County White	No. 77 U. S. Dept. Agr.
Champion White Pearl	Reid's Yellow Dent
Early Mastodon	Riley's Favorite
Golden Beauty	Silver Mine
Golden Dent	Snowflake
Hickory King	Saint Charles

Late varieties.

Albemarle	Marlboro
Arnold	McMackin's Gourd Seed
Bradbury	Mexican June
Cade's Prolific	Mosby
Cocke's Prolific	Poor Man's
Creole	Red Cob
Experiment Sta. Yellow	Renfro
Evans	Sanders
Farmers Pride	Shaw
Henry Grady	Strawberry
Higgins	Tennessee White
Jones Pearl Prolific	Tennessee Yellow
Local White Cob	Welborn's Conscience

Of course still further sub-division of each class is possible. For example, we might place St. Charles in a medium early group, and probably include Blount in the same. Subdividing the second group, we should have as medium to late, Albemarle, Marlboro, Evans; and as very late, Creole, Poor Man's and Mexican June.

The yields of the late and medium late varieties are very much greater than the yields of the early varieties.

The large-eared group consists of late varieties, except Early Mastodon and St. Charles.

The medium-eared group includes both early and late varieties, the late prodominating.

The small-eared group is made up chiefly of the early northern varieties and the prolific or many-eared kinds; it thus includes both the most unproductive and the most productive varieties.

SEED CORN FROM DIFFERENT LATITUDES.

This series of experiments has been under way for nine years under the present management. The plots for this experiment have always been located on upland soil, naturally poor, on the Station farm at Auburn.

The northern or western seed corn used in all of these eight years has come from the same grower, J. C. Suffern, Voorhees Post Office, in the central part of Illinois, in latitude 39 degrees and 50 minutes, or about one degree north of St. Louis. This northen seed corn has been compared with, (1) seed corn of the same varieties grown in Georgia and Alabama and, (2) with seed corn from Virginia, Delaware and Knoxville, Tennessee.

Tests of this character are beset with difficulties and results are not easy to interpret, for the reason that other factors besides climate enter into the problem. The soil in which each strain has recently grown, the carefulness of different growers in maintaining the purity and excellence of their strains of corn, and other factors complicate the results. Nevertheless, the average of a number of experiments extending over nine years and made with four different varieties should afford reliable indications.

For detailed tabulated results the reader is referred to the Appendix to this bulletin.

In sixteen separate tests, in which seed from Alabama or Georgia was compared with the same variety from Illinois, the yields were in eight cases in favor of seed corn from

Alabama and Georgia and in eight cases in favor of seed corn from Illinois. The average difference in yield was only thirty five one-hundredths of a bushel per acre, in favor of northern seed. Thus the seed from the two sources proved to be of practically equal value so far as regards the average of results with Hickory King, Blount and St. Charles. These varieties may be ranked as early or medium early varieties as compared with southern varieties. Our variety tests show that they are relatively unproductive here, like all other early varieties of corn. It seems that while northern seed corn has afforded as large yields as southern in the case of early varieties, it is advisable for the southern farmer to give the preference to southern seed corn, for the reason that he cannot, in the North, obtain seed of the varieties that are most productive in the South, the season there being too short for our best southern varieties.

Comparing seed corn from Illinois and Delaware we find that each led in one test, the difference in their average yields being very slight.

In each of three tests seed grown in Virginia proved decidedly more productive than seed of the same varieties, (Hickory King and Blount), grown in Illinois. The average difference in favor of Virginia seed was 8.5 bushels per acre.

In three out of four tests, using the varieties Hickory King, Blount and Cocke the yields decidedly favored the Virginia seed, as compared with seed from Alabama and Georgia, the average difference for the four tests being 4.9 bushels per acre in favor of the seed corn from Virginia.

Using the same three varieties just mentioned and comparing seed grown at Knoxville Tennessee, with seed from Alabama and Georgia, we find that in each of four tests the advantage was with the Tennessee seed, the average difference being 2.3 bushels per acre.

Thus on the whole there was some advantage in using seed from Virginia and from the more elevated region of Tennes-

see, as compared with seed of Cocke, Hickory King and Blount grown in Georgia and Alabama.

Are these differences due to climate, or are they due to more careful selection and greater purity of the seed from certain regions? A positive answer cannot be given. The writer's own opinion is that the difference is chiefly due to selection. If this be the correct view, it follows that the only thing needed to make Alabama seed corn the equal or superior to that from any other part of the country is to improve it by careful selection. Methods of thus improving corn will be dealt with in a later publication from this Station.

In view of results here recorded and of observations made elsewhere, the writer's conclusions relative to the source from which we, of the Gulf States, may advantageously draw our seed corn may be stated as follows:

Varieties of corn from north of the Ohio river usually give smaller yields in Alabama than corn grown further south.

Seed corn from the northern corn belt is sometimes useful in the Gulf States as a means of securing a field of early maturing corn, especially when the local corn crop of the preceding year has been poor. On such early ripening patches we need not expect as large yields as are obtained from corn maturing at the usual time.

Corn from the northern corn belt has often given, in Alabama, a very poor quality of grain, which has often been too poor for marketing or for making meal.

For planting in Alabama, seed corn of late and prolific varieties may safely be obtained from any locality south of the Ohio and Potomac rivers, and perhaps slightly above this line.

Seed corn from about the same latitude as that in which it is to be grown appears to be as good as that from further north, provided it is as well selected and maintained as pure as the imported strain. Local seed corn, when pure

and well improved, has the advantage of permitting the grower to select it in the ear, the condition in which it is desirable that all seed corn, whether local or from a disanee, should be received by the farmer,

Corn brought south from higher latitudes becomes later and later each year for several years after its introduction, the plant grows taller, and generally the proportion of trashy, weevil-eaten or otherwise unmarketable grain becomes less than during the first year of growth in the South.

TOP VERSUS BOTTOM EARS.

To ascertain whether there is any difference for seed purposes between the lower and the upper ear on plants bearing two ears, tests were made in 1903 and in 1905.

The results in 1903 with St. Charles White corn were as follows, in bushels per acre:

From upper ear.....................25.0 bushels per acre.
From lower ear.....................22.8 bushels per acre.

In 1905 five pairs of plots were used, planting seed corn from five different plants of the variety Experiment Station Yellow. Plots 1 and 2 were planted with upper and lower ears respectively from the same plant, plot 3 with corn from the same plant as plot 4, and so on for each pair of plots.

Yields in 1905 *from planting upper and lower ears from the same plant.*

Plot No.	Seed corn from.	Yield per acre from Top ears Bus.	Yield per acre from Bottom ears. Bus
1.	Top ear	26.3	——
2.	Bottom ear	——	27.7
3.	Top ear	30.0	——
4.	Bottom ear	——	29.4
5.	Top ear	32.9	——
6.	Bottom ear	——	33.1
7.	Top ear	28.5	——
8.	Bottom ear	——	29.4
9.	Top ear	27.1	——
10.	Bottom ear	——	28.6
Average 5 plots top ears		28.9	——
Average 5 plots bottom ears		——	29.6
Increase from bottom ears over top ears			.7

Viewing the six tests made in the two years we note that the yield was greater with seed from bottom ears in four cases and with seed from the upper ears in two cases. In 1905 the average number of ears and nubbins combined and their average size or weight were almost identical from planting upper and lower ears. This evidence is not sufficient to justify the conclusion that the bottom ear is better than a well developed upper ear, or the reverse.

SUBSOILING.

A tract of level rather poor upland has, for ten years, been devoted to continuous experiments in subsoiling, using different crops each year. The surface soil is made up of flinty stones and of rather stiff reddish loam. The subsoil is a very compact yellowish sandy clay, which in winter is usually too wet for the subsoil plow to do effective work. A regular subsoil plow drawn by two mules is run in the furrow made by a one-horse turn plow, giving a total depth of from 10 to 12 inches of loosened soil. Subsoiling is not done every year, but every second or third year. The following table shows that when the land for corn was subsoiled only about six weeks before corn was planted, the yield was slightly less on the subsoiled plots than on those not subsoiled. When subsoiling was done two years before planting, this operation resulted in a slight increase in yield.

Immediate and third year effects of subsoiling.

Crop grown in	When subsoiled	Yield per acre		Loss from subsoiling	Gain from subsoiling
		Not subsoiled	Subsoiled		
		Bus.	*Bus.*	*Bus.*	*Bus.*
1901	Never subsoiled	13.1	....	....	....
1901	Subsoiled Feb. 1901	....	11.2	1.9	....
1903	Never subsoiled	13.8	....	....	....
1903	Subsoiled Feb. 1901	....	14.5	....	.7
Average loss from subsoiling		....	....	.6	....

Subsoiling should not be condemned simply on this showing. The figures, together with slightly better results on the same land with some other crops, should emphasize the fact that subsoiling done within two months of the time of planting may have an injurious effect. It is believed that land of this character would be helped by using the subsoil plow during long dry periods in the fall when the subsoil is dry enough to crumble.

DEPTH OF EARLY CULTIVATION.

In 1900 on rather stiff reddish soil, with flinty stones, there was no injury from making the first cultivation deep with two scooter furrows per row, all subsequent cultivations being shallow.

In 1901 on gray sandy upland the yield was 23.6 bushels on the three plots cultivated shallow and 23.4 bushels on those given an early deep cultivation with two scooter furrows per row, the subsequent cultivation being shallow. Thus in both experiments there was no marked advantage in favor of making the first cultivation deep. However, it should be noted that in both tests the first cultivation or "running around" was given when the plants were only a few inches high. If cultivation had been delayed as late as sometimes occurs, the injury from early deep cultivation would doubtless have been appreciable. When land is in good condition there seems to be no need for deep early cultivation. Possibly when clay land has been plowed early and has become badly compacted there may be some justification of "running around" the young plants with a scooter. But in general the danger of injury to roots, of excessive drying of the soil if dry weather follows, and the slowness of this process, are against this primitive method of cultivation.

PLANTING CORN IN WATER FURROW VERSUS ON A LEVEL.

On light sandy lands farmers frequently plant corn below the general level, or in the water furrow. This method was

compared with planting on the level flushed field, both in 1900 and in 1901.

In preparing to plant corn in the water furrow the land was thrown into beds with a one-horse turn plow, leaving unbroken until planting time a narrow balk where the corn was to be planted. When ready to plant, this balk was thrown out with a shovel plow and seed and fertilizer placed in this freshly-stirred soil. Likewise seed and complete commercial fertilizer were applied on the same day in the furrow on the plot that was planted on the level. In both cases the fertilizer was mixed with the soil before the seed were put into the ground.

The yields in bushels per acre were as follows:

	1900	1901
Planted on the level........................	22.2	16.5
Planted in water furrow....................	19.0	16.5

In 1900, in which April and June were wet months, there was a loss even on this porous soil, from planting in the water furrow. In 1901 when there was abundant rain from time of planting until June 15, but a drought from the middle of June to the middle of July, the yields by the two methods were identical.

METHODS OF HARVESTING CORN.

The ordinary method of harvesting corn in the Gulf States consists in stripping the blades while they are still green, a practice that is expensive in labor and in the decreased yield of grain that frequently results. In recent years in many southern localities a number of farmers have cut and shocked the plants when the shucks have colored, afterwards passing the plants through a shredder to remove and shuck the ears, and better to prepare the stalk for food and bedding. Rarely the tops are cut, bound into bundles, and cured.

An experiment covering this point was made in 1904, to secure data additional to that obtained in our earlier ex-

periments in 1896, 1897 and 1900. The yields in 1904 were as follows:

Yield per acre of corn and forage from different methods of harvesting in 1904.

Method of harvesting	Corn per acre.	Forage per acre.
Only ears harvested	25.7 bus.	00 lbs.
Tops cut and ears harvested	26.1 bus.	360 lbs.
Entire stalk cut and ears afterwards harvested	25.4 bus.	1980 lbs.
Blades stripped and ears harvested	25.5 bus.	415 lbs.

In 1904 there were practically no differences in yield attributable to the method of harvesting.

The table below summarizes the yield of corn in four experiments made at Auburn, the results of the earlier years having been published in Bulletins Nos. 88 and 111 of this station.

Yield per acre of corn from different methods of harvesting.

Methods of harvesting	Corn per acre					
	1896	1897	1900	1904	Average 4 years	Average loss
	Bus.	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*
Only ears harvested	34.4	31.0	46.9	25.7	34.5	.....
Tops cut and ears harvested	30.2	29.2	44.3	26.1	32.5	2.0
Entire plant cut and shocked	29.2	29.5	44.3	25.4	32.1	2.4
Blades stripped and ears harv't'd	.....	.....	45.9	25.5	.....	.....

This table shows that the average loss of grain per acre where the tops only were saved for forage was 2 bushels, or where the plant was cut and shocked, 2.4 bushels per acre. Both losses were greater than in most of the experiments at other stations. As to the effects of pulling fodder, we have data for only two years. The average of all experiments at all stations show that generally stripping the blades reduces the yield by several bushels per acre, but that under some conditions (probably when the stripping is late) no material reduction in yield occurs.

The following table shows the amount of forage derived from "fodder pulling," from topping, and from shocking.

Yields of cured corn tops, stover and blades.

	Average yield of grain	Yield of forage per acre					
		1896	1897	1900	1904	Avg.	
	Bus.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
Only ears harvested	34.5	......	......	......	......	......	......
Tops cut and ears harvested	32.5	312	509	711	360	473	Tops
Entire stalk cut and ears afterwards harvested	32.1	2103	1355	1759	1980	1799	Stover
Blades stripped and ears harvested ..	......	......	......	615	415	515	Blades

It should be noted that the average amount of cured blades per acre was 515, of cured tops 473 and of cured stover (leaves and stalks) 1799 pounds. It is evident that we can expect less than a ton of stover per acre on southern uplands when the yield is thirty-five bushels or less per acre.

When only the ears are harvested, partial utilization may be made of the weather-worn blades, and of leaf sheaths and tips of stalks, by pulling the ears early and turning cattle into the field. Where labor is scarce, other winter forage abundant, and a shredder not at hand, this may prove to be the most practicable method.

Considering the cost and usual injurious effects of fodder pulling, this method of obtaining forage must be condemned.

This Station is accumulating data relative to the feeding value of shredded corn stover, which may throw further light on the advisability of shocking and shredding corn, the method that is usually regarded as the best.

Assuming—in the absence of a sufficient number of exact experiments in feeding tops and stalks,—that tops are worth 40 cents, stover 30 cents per 100, and corn blades 60 cents, we find that one acre gives a value of $1.80 in corn

tops; or of $3.09 in corn blades or "fodder," and of $5.40 in stover.

Cutting and shocking can be done before cotton picking begins, a merit that will be generally recognized. Moreover, the cutting of the stalks leaves the land in better condition for plowing, and enables the farmer to begin the plowing for small grain at an earlier date than is practicable when the ears are allowed to cure slowly on the living plants. The removal of the stalks is somewhat more exhaustive to the land than is burying them with the plow, but this on most soils is probably counterbalanced by the greater convenience of preparing and cultivating land that is free from stalks.

LEGUMINOUS PLANTS AS FERTILIZERS FOR CORN.

Velvet bean stubble vs. vines as fertilizer for corn in 1901.

In 1900 velvet beans were planted after oats in 4 feet rows on certain plots of light sandy upland adjacent to the land on which for a long period our fertilizer experiments with cotton and corn were conducted. On certain other plots corn was grown in 1900.The velvet bean vines were cut for hay on a part of the area, yielding 3332 pounds of hay per acre.

In 1901 corn was grown on all plots, using on all acid phosphate at the rate of 100 pounds per acre. The object was to note the comparative values as fertilizer of (1) the entire velvet bean plants plowed under late in winter, (2) the stubble of velvet beans, plowed in at the same time, and (3) as a check, corn stalks of the preceding corn crop.

	Yield per acre *Bus.*	Increase per acre *Bus.*
Corn following corn	13.6	....
Corn following velvet bean stubble	17.9	4.3
Corn following velvet beans, entire growth plowed in	25.9	12.3

The increase attributable to the plowing in of the entire growth of velvet beans, grown as a catch crop after oats,

was 12.3 bushels per acre, this increase being worth, at 70 cents per bushel, $8.61 per acre. Doubtless there was also a considerable residue of humus and nitrogen left in the soil to increase the crop of 1902.

The cost of growing the velvet beans consisted chiefly of expenditures for 200 pounds of acid phosphate per acre, for the seed, and for a small amount of cultivation. By using the entire crop of velvet beans as fertilizer the yield of the first crop of corn was nearly doubled.

The plot on which only the stubble of velvet beans was used for hay afforded an increase of 4.3 bushels per acre, and lacked 8 bushels of giving as large a crop as the plot on which the entire growth was plowed under. Hence in deciding which was the more profitable use of the velvet bean vines we have on one side 8 bushels of corn and the saving of labor from not harvesting the hay and on the other hand the value of more than one and a half tons of hay.

As recorded in Bulletin 111 of this Station, (the issue of which is now exhausted), in 1900 on a similar and adjacent soil, the increase in yield of corn after plowing in the entire vines of velvet beans of 1899, as compared with plowing in only the velvet bean stubble, was 11.9 bushels per acre. That year the yield of velvet bean hay was 2800 pounds.

On the same plots in 1901 on all of which corn was the preceding crop, the residual fertilizing effect of the 1899 crop of velvet beans was 4.4 bushels greater where the entire growth of vines had been plowed under than where only the stubble had been plowed under. Here we have in two years a total superiority of vines over stubble of 16.3 bushels of corn per acre, which may be weighed against 2800 pounds of velvet bean hay, less the cost of harvesting the hay.

Cowpea stubble versus cowpea vines as fertilizer for corn.

On a poor reddish loam upland soil cowpeas were sown in drills June 13, 1900, following oats, and fertilized with 150 pounds of acid phosphate per acre.

A part of the cowpea area was cut, yielding 1648 pounds of hay per acre. On another part of the area the peas were neither cut nor picked, but the entire growth turned under.

In 1901 corn was grown on both areas, and was fertilized with 100 pounds of high grade acid phosphate per acre. The yields of corn in bushels per acre were as follows:

After drilled cowpea stubble.................11.4 bushels
After drilled cowpeas, all plowed in.........20.3 bushels
Excess from entire growth of cowpeas as compared with cowpea stubble............ 8.9 bushels

Beggar weed as a fertilizer for corn.

On June 24, 1899, beggar weed seed were sown on certain plots on a poor hilltop, where the soil is a light gray sandy loam. The growth that year was only medium and the stand poor, but some of the plants matured and shed seed.

The entire growth of beggar weed was plowed under during the winter, as was also the stubble of drilled velvet beans on adjacent plots, and all plots planted in corn in 1900 and again in 1901. After cultivation of the corn ceased in 1900 beggar weeds sprang up , reseeded the land, and this volunteer crop was plowed under as a fertilizer for the corn crop of 1901.

As compared with the plot where velvet bean stubble was left in 1899, the increase on the plots where beggar weeds were plowed in immediately preceding each corn crop was 3.1 bushels in 1890 and 7.6 bushels in 1901, an average annual increase of 5.4 bushels per acre. Doubtless this increase, especially in 1900, would have been considerably greater could the comparison have been made with some plot on which no legume had recently been grown.

Acid phosphate as a fertilizer for corn grown after velvet beans.

In 1901 acid phosphate containing 14 per cent. available phosphoric acid was applied to corn on poor gray sandy up-

land. No other fertilizer was used, but on both plots the entire growth of velvet bean vines had been plowed under late in the winter. The yield without any phosphate was 21.5 bushels per acre; with 100 pounds of phosphate 25.9 bushels. This difference of 4.4 bushels of corn per acre represents the effect of 100 pounds of high grade acid phosphate when applied in the presence of abundance of vegetable matter.

Likewise in 1905 a test was made to determine whether, after plowing under a luxuriant growth of velvet bean vines, it would pay to apply commercial fertilizers in addition.

On level sandy land in good condition a very heavy growth of velvet bean vines was plowed under with a disc plow February 27, 1905. On the adjacent plots on either side there was plowed under at the same time and in the same way the stubble of drilled sorghum which had been cut for hay. Two of the velvet bean plots received no other fertilizer than the vines and two of them, besides the vines of velvet beans, were also fertilized with 40 pounds of muriate of potash and 240 pounds of acid phosphate per acre.

Average results for two plots in each test are given below:

Yield of corn per acre fertilized with velvet bean vines alone........................21.3 *bushels.*
Fertilized with velvet bean vines, potash and phosphate ....27.3 *bushels.*
Increase from potash and phosphate............6.0 *bushels.*

In this experiment it was profitable to employ as fertilizer for corn, muriate of potash and phosphate, in addition to a mass of velvet bean vines. The gain from this mineral fertilizer, when used in the presence of an abundance of vegetable matter, was 6 bushels per acre.

A crop of velvet bean vines turned under gave practically the same yield of corn as did a very heavy application of the best grade of barnyard manure, applied on adjoining plots, at the estimated rate of about ten tons per acre.

FRACTIONAL APPLICATIONS OF FERTILIZER.

It is a favorite plan of some farmers to apply only a part of the fertilizer to cotton or corn before planting, and to apply the remainder after growth has well begun.

After the publication of Bulletin No. 111, in which it was shown that corn had not responded very freely to large applications of commercial fertilizers, the writer received several letters suggesting that the results with fertilizers would have been much better if a part of the fertilizer had been withheld until the plants were one or two feet high.

To test this matter again eight plots were employed in 1905, located on fairly good upland, where the soil is a reddish loam, containing many flint stones.

The fertilizer applied before planting was drilled in the planting furrows and mixed with the soil March 7, and planting was done March 29. The portion of fertilizer withheld was applied on certain plots May 15, in the siding furrows of the second cultivation.

Fractional application of fertilizer for corn in **1905.**

Plot number.	FERTLIZER			Yield per acre	Increase over unfertilizer plots
	Amount per acre	Kind	Time applied		
	Lbs			*Bus.*	*Bus.*
1	200 200 40	Cotton seed meal .... Acid phosphate ...... Muriate of potash	All at planting	25.1	......
2	200 200 40	Cotton seed meal .... Acid phosphate ...... Muriate of potash	½ of fert. at planting .... ½ of fert. at 2nd cult.	24.0	......
3	00	No fertilizer	....	19.4	......
4	200 200 40	Cotton seed meal .... Acid phosphate .... Muriate of potash	All at planting	20.9	......
5	200 200 40	Cotton seed meal .... Acid phosphate ...... Muriate of potash	½ of fert. at planting .... ½ of fert. at 2nd cult.	22.6	......
6	00	No fertilizer	....	20.0	......
7	200 200 40	Cotton seed meal .... Acid phosphate .... Muriate of potash	½ of fert. at planting .... ½ of fert. at 2nd cult.	24.0	......
8	200 200 40	Cotton seed meal .... Acid phosphate .... Muriate of potash	All at planting	25.4	......
Av. 3,6	00	No fertilizer	....	19.7	......
Av. 1,4,8	200 200 40	Cotton seed meal .... Acid phosphate ...... Muriate of potash	.... All at planting	23.8	4.1
Av. 2,5,7	200 200 40	Cotton seed meal .... Acid phosphate ...... Muriate of potash	½ of fert. at planting .... ½ of fert. at 2nd cult.	23.5	3.8

Wherever fertilizer was employed a complete fertilizer, at the rate of 240 pounds per acre, was used. The average results show a difference of three-tenths of one bushel per acre in favor of applying the entire amount before planting.

In favor of this method is also the greater convenience and saving of labor.

The corn receiving the entire amount of fertilizer before planting made a much better start than did the other plots, but the difference nearly disappeared late in the season.

The increase due to 240 pounds of a complete fertilizer was only 4.1 bushels when all was applied before planting, and only 3.8 bushels when applied in two doses.

COTTON SEED VERSUS COTTON SEED MEAL AS FERTERLIZER.

In 1901, 200 pounds of cotton seed meal was compared with 434 pounds of cotton seed, these amounts containing equal quantities of nitrogen. The cotton seed was scalded to prevent germination and all fertilizers were applied in the drill April 8. Acid phosphate at the rate of 160 pounds per acre was used on all plots.

Increase from 200 pounds cotton seed meal......2.8 bushels
Increase from 434 pounds cotton seed..........2.3 bushels

This shows a slight superiority the first year for cotton seed meal.

An experiment made in 1897 on similar soil, comparing 200 pounds of cotton seed meal with 434 pounds of cotton seed, all applied when corn was planted, April 7, also resulted in a slight advantage for cotton seed meal.

In 1904 and again in 1905 on the same plots a comparison was made between the following nitrogenous fertilizers:

Cotton seed meal, 200 pounds per acre; cotton seed, 434 pounds; manure (unleached) from feeding steers on cotton seed meal and sorghum hay, 4800 pounds; 100 pounds of nitrate of soda; and a mixture of nitrate of soda and cotton seed meal. To prevent germination the cotton seed were scalded in 1904 and ground in 1905.

Cotton seed meal versus cotton seed, nitrate of soda and stable manure.

Fertilizers per Acre.		Yield per Acre.			Increase per acre from nitrogenous fertilizers.		
Am't. per acre.	KIND	1904	1905	Av.	1904	1905	Av.
Lbs.		*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bu.*
200 240 48	Cotton seed meal ...... Acid phosphate .... Muriate of potash	22.9	18.9	20.9	1.8	2.2	2.0
434 240 48	Cotton seed .... Acid phosphate .... Muriate of potash	21.0	17.8	19.1	.8	.7	.8
240 48	Acid phosphate .... Muriate of potash	20.2	17.1	18.7	....	....	....
100 240 48	Nitrate of soda, 2nd cult. Acid phosphate .... Muriate of potash	27.3	21.1	24.2	7.1	4.0	5.6
100 50 48 240	Cotton seed meal ...... Nitrate of soda .... Muriate of potash ...... Acid phosphate	25.2	21.2	23.2	5.0	4.1	4.6
33 67 240 48	Nitrate of soda (at plantg Nitrate of soda, 2nd cult Acid phosphate .... Muriate of potash	29.3	24.4	26.8	9.1	7.3	8.2
4800	Manure from steers fed cotton seed meal and hulls or sorghum fodder	24.2	22.3	23.5	4.0	5.2	4.6

This soil did not respond very generously to any of the fertilizers in either year, although it had been rather exhaustively cropped with silage corn, wheat and sorghum, and had borne no leguminous plant for at least two years before the beginning of this experiment.

It is obvious that cotton seed meal was more effective than cotton seed; that a mixture of cotton seed meal and

nitrate of soda was still more useful; and that nitrate of soda was more beneficial than any other fertilizer. One pound of nitrate of soda afforded a greater average increase than 48 pounds of manure made under shelter by feeding steers on cotton seed meal and coarse sorghum fodder. Unexpectedly there seems to have been but little cumulative or second-year effect from either cotton seed or manure. This experiment is being continued on the same plots, using wheat as the crop, and we may reasonably expect that as this experiment is continued we shall obtain some cumulative effect from the manure.

There was an advantage both years in applying one-third of the nitrate of soda with the other fertilizers before planting, instead of reserving all this for use at the second cultivation. Nitrate of soda is believed to be the only fertilizer which can be applied to corn with as much advantage after growth begins as before planting.

A number of fertilizer experiments have been made with corn. But these will not be published until some of these tests have been further repeated. In general they point to the conclusion that corn, growing on average upland soil in Alabama, usually requires a fertilizer rich in nitrogen, and that the application of very large amounts of commercial fertilizers for corn is not very profitable.

The following fertilizer formulas for corn are suggested:

(A) 100 lbs. acid phosphate,
50 lbs. nitrate of soda, (both just before planting).
50 lbs. nitrate of soda, at second cultivation.

(B) 100 lbs. acid phosphate
200 lbs. cotton seed meal, (both before planting).

Credit is due to the following for participation in the experiments detailed in this bulletin: T. U. Culver, formerly superintendent of the farm; C. M. Floyd, superintendent of the farm during 1904 and 1905; and L. N. Duncan, assistant in agriculture, who has prepared most of the tables in this bulletin.

APPENDIX

Seed corn from different latitudes.

Year	Variety	Seed from	Yield per acre: Seed from Ill.	Yield per acre: Seed from Gulf Region	Yield per acre: Seed from Del. & Va.	Increase per acre from: Gulf Region over Ill. seed	Increase per acre from: Va & Del. over Ill. seed	Increase per acre from: Gulf over Va, Del & Tenn seed.
						Bus.	*Bus.*	*Bus.*
1896	Hickory King	Alabama		16.5		—2.8		
do	do	Illinois	19.3					
do	do	Delaware			15.6		—3.7	
1896	Blount Prolif	Ga. (South)		13.1		—1,1		
	do	Illinois	14.2					
1897	Hickory King	Alabama		12.1		—2.2		
do	do	Illinois	14.3					
897	Blount Prolif	Ga. (South)		18.9		— .2		
do	do	Illinois	19 1					
1898	Hickory King	Ga. (North)		11.4		1.0		
do	do	Illinois.	10.4					
1898	Blount Prolif.	Ga. (North)		11.0		.5		
do	do	Illinois	10.5					
1899	Blount Prolifi.	Georgia		17.1		1,9		
do	do	Illinois	15 2					
1899	St. Charles	Alabama		15.3		—.8		
do	do	Illinois	16.1					
1900	St. Charles	Ala.(1 year)		34.2		1.1		
do	do	Illinois	33.1					
1900	Blount Prolif.	Ga. (South)		32.2		1.9		
do	do	Illinois	34.1					
do	do	Virginia			36 8		2.7	—4.6
1900	Cocke Prolif.	Ga. (South; J.)		32 6 (Av.36.5)				
do	do	Ga. (South; A)		38.4				
do	do	Ga. (North)		38 6				
do	do	Virginia			41.7			—5.2
1900	King Hickory	Virginia			29.8			
do	do	Delaware			20 4			

Seed corn from different latitudes. (*Continued*).

Year	VARIETY	Seed from	Yield per acre: Seed from Illinois	Yield per acre: Seed from Gulf Region	Yield per acre: Seed from Va., Del. and Tenn.	Increase per acre: Gulf Region over Illinois seed	Increase per acre: Gulf Region over Va., Del. and Tenn.	Increase per acre: Va., Del. and Tenn. over Ill. seed
1901	Blount	Georgia	....	22.6	....	....	....	....
do.	Blount	Illinois	27.3	....	....	-4.7	....	....
1901	St. Charles White	Alabama	....	18.9	....	....	....	....
do.	St. Charles White	Illinois	24.6	....	....	-5.7	....	....
1903	Hickory King	Georgia	....	20.7	....	.6	....	....
do.	Hickory King	Tenn.	....	....	24.3	....	-3.6	4.2
do.	Hickory King	Illinois	20.1	....	....	....	....	....
1903	St. Charles White	Illinois	23.5	....	....	....	....	....
do.	St. Charles White	Alabama	....	23.9	....	.4	....	....
1904	St. Charles White	Illinois	20.5	....	....	....	....	....
do.	St. Charles White	Alabama	....	27.7	....	7.2	....	....
1904	Cocke	North Ga	....	31.2	....	....	.8	....
do.	Cocke	Virginia	....	....	30.4	....	....	....
do.	Cocke	Tenn.	....	....	33.4	....	2.2	....
1904	Hickory King	Virginia	....	....	31.7	....	-10.7	11.8
do.	Hickory King	Illinois	19.9	....	....	....	....	....
do.	Hickory King	Delaware	....	....	22.7	....	-1.7	2.8
do.	Hickory King	North Ga.	....	21.0	....	1.1	....	....
do.	Hickory King	Tenn.	....	....	22.0	....	-1.0	2.1
1904	Blount	Virginia	....	....	25.2	....	....	....
do.	Blount	Illinois	14.3	....	....	....	....	10.9
1905	Cocke	Alabama	....	28.6	....	....	....	....
do.	Cocke	Tenn.	....	....	30.9	....	-2.3	....

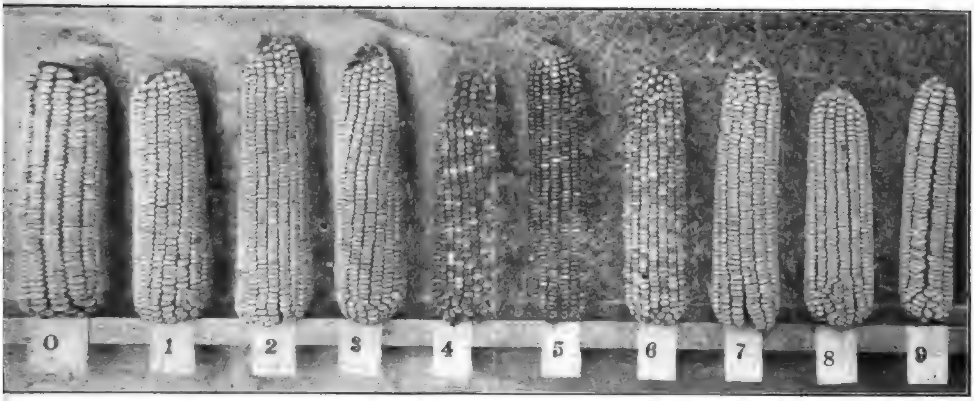

Fig. I. 0, 1 *and* 2, *Boone County White;* 3, *Boone County Special;* 4, *Leaming;* 5, *Experiment Station Yellow;* 6, *Reid Yellow Dent;* 7, *No.* 77 *U. S. Dept Agr.;* 8, *Iowa Silver Mine;* 9, *Hickory King.*

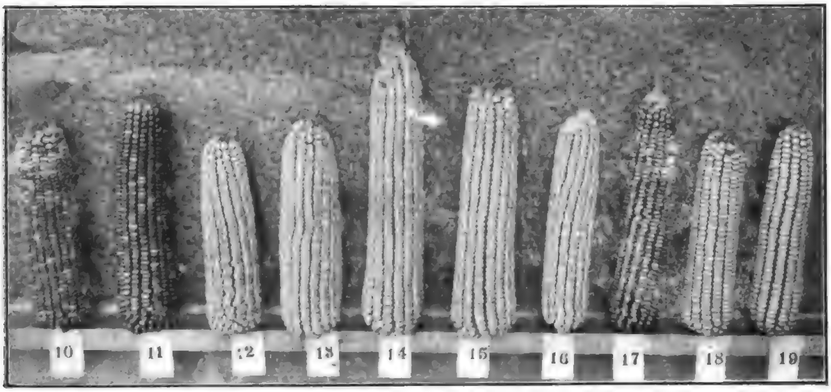

Fig. II. 10, *Riley Favorite;* 11, *Experiment Station Yellow;* 12, *Sanders;* 13, *McMakin's Gourd Seed;* 14, *Local White Cob;* 15, *Henry Grady;* 16, *Mosby;* 17, *Experiment Station Yellow;* 18, *Marlboro;* 19, *Cocke.*

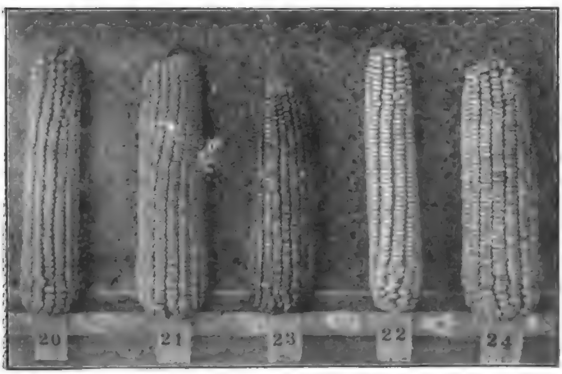

Fig. III. 20, *Cocke;* 21, *Shaw;* 22, *Albemarle;* 23, *Experiment Station Yel-*

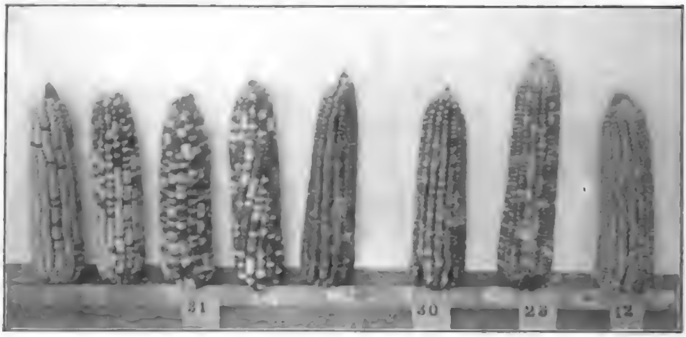

Fig. IV. 31. Lead colored Mexican June and crosses: 29 and 30, Experiment Station Yellow, with cross on lead colored Mexican June; 12, Sanders, with few lead colored grains.

Fig. V. White (or ordinary) Mexican June Corn.

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Bulletin

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

Diseases of Sweet Potatoes in Alabama.

(A Preliminary Report.)

BY

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

DISEASES OF SWEET POTATOES IN ALABAMA

E. Mead Wilcox, Ph. D.

INTRODUCTION.

The sweet-potato crop in Alabama is one of importance and one that, no doubt, will increase in value from year to year. At present Alabama stands fourth in order among the sweet-potato growing states. According to the census report for 1900, covering the year 1899, Alabama produced 3,457,386 bushels of sweet potatoes on 50,865 acres. Assuming the average value of the crop as $0.49 cents per bushel, as done in this report, the average value of this crop per acre during 1899 was $33.17. The following counties produced over 100,000 bushels: Dallas, Henry, Jefferson, Montgomery and Wilcox; and Montgomery county produced 163,832 bushels.

The value of the crop is much enhanced if it is possible to hold it until it can command the much higher prices that prevail during the winter and early spring. Methods of storage, therefore, deserve attention and it is our plan to make a thorough investigation of the subject in connection with some of the growers who now try to hold over a part or all of their crop. Some of the diseases which are mentioned in this bulletin are most serious obstacles to the storage of sweet-potatoes, and it is here largely, rather than during the growing season, that sweet-potato diseases cause the greatest losses. It has seemed wise in advance of the publication of our study of storage methods to publish here a summary of our present knowledge of sweet-potato diseases to include the work upon the subject done here and elsewhere.

It is hoped and urgently requested that all who grow sweet potatoes will assist us in this investigation by reporting all sweet potato diseases to this office promptly, accompanied by specimens of the diseased plants. In this manner

CHICKEN-POX, SORE-HEAD OR CONTAGIOUS EPITHELIOMA IN POULTRY

By C. A. Cary.

INTRODUCTION.

This disease occurs in nearly every county in Alabama during the spring summer or fall of every year. It is more prevalent among young chickens, from broilers to maturity; yet younger and older chickens may have this disease. It is a common poultry disease and very probably more deaths occur from sore-head than from any other poultry disease in Alabama. Such a high mortality can be avoided with proper care and treatment.

The poultry industry in Alabama is not as extensive and as carefully and thoroughly worked as it should be. The extensive home markets in the mining and manufacturing regions of the South will take care of a much larger supply of chickens, ducks, turkeys and pigeons. The conditions in the South are ideal if the poultry business is conducted with that care and knowledge which are required in any place to bring success. With a small capital, plenty of regular work applied intelligently, it will bring as good returns as any line of the live-stock industry.

FORMS OF THIS DISEASE.

There are no positive differences between the various forms of diphtheria, roup and chicken pox or "sore-head" other than the locality in which the lesions occur; and possibly the per cent. of mortality in the different forms of the disease. Usually when the mouth, throat, air passages or alimentary canal in one or more places is peculiarly inflamed so that an organized or solid exudate is formed on the surface of the inflamed mcous membrane and that mem-

brane bleeds rather freely when the diphtheritic exudate is torn away—such a diseased condition is called fowl (avian) *diphtheria.*

If the nasal passages and the cavities connected therewith have their mucous membrane inflamed producing a catarrhal (mucous) exudate, or solid, dried pus-like exudate in the nasal cavities, and sometimes pushing outward the tissues around the eyes—such a diseased condition is called "roup."

If the skin of the wattles, comb, ear lobes, eyelids or of the head and sometimes the conjunctiva (the mucous membrane lining, the eye-lids and reflected over the front part of the eye-ball) becomes inflamed in such a way as to produce crusts or scabs or an exudate of dried pus, broken down epithelical cells, etc—such a condition is called chicken-pox or "sore-head" or *epithelioma contagiosum.*

CAUSES.

The causes of these diseases, or this disease, have been attributed to coccidia (one-celled protozoa) to various bacteria and to ultra-microscopical organisms.

Neumann (11) gives the following:

"*Coccidia* or *Psorospermiae oviformes* constitute, in the class of sporozoa, an order in which the majority of the species belonging to it live as parasites in the interior of epithelial cells of the liver, intestine, skin, etc. At the commencement of their development these coccidia form small protoplasmic regularly rounded masses, which are usually nucleated. Gradually each of these masses increases in volume and becomes surrounded by a transparent membrane—the *cyst* or *shell*—and rupturing the cell into which it had penetrated, it falls into the biliary ducts, the intestine, the epidermic layers, etc. Thus liberated, the encysted coccidium passes through a phase of segmentation—its protoplasm becoming condensed, then dividing into several spheres or spores,

Each spore in its turn subdivides into a number of corpuscles—*falciform corpuscles*—which, meeting with favorable conditions each becomes a new ameboid individual that invades an epithelial or epidermic cell, grows there and recommences the cycle of its progenitor."

Oslertag (9) says:

"Coccidia are parasites of epithelia. They are small, spherical or oval structures which destroy the epithelial cells by their rapid growth and then divide into a number of parts. These penetrate into the intact epithelia of the infested organ (*merozoites*) or become changed into microgametes and macrogametes (male and female sexual cells). By the copulation of these forms sporoblasts are produced and, finally, permanent forms with shells (*sporozoites*) arise. The latter cause infestation of new hosts." The sporoblasts (a) are elongated, oval and surrounded by a double capsule, at first the protoplasm entirely fills the capsule as a coarsely granular mass, but soon becomes contracted into a sphere from which four sporozoits arise. In the rabbits' liver infested with coccidia, round, white, abscess-like foci are formed.

Friedberger and Frohner (13) give the following:

Coccidia "are at first naked inhabitants of epithelial cells. By penetrating into the cells of the mucous membrane and by filling up these cells (in many cases completely, so that the enclosed coccidia assume the appearance of large nuclei), they produce grave disturbance of nutrition and this tends to induce necrosis of the parts attacked." "Gregarinous croupy diphtheritis is distinguished by the ease with which the disease extends from the mouth to the skin of the head. It can be readily transmited artificially, and is generally not difficult to cure, especially when it is confined to the mucous membrane of the mouth, pharynx, upper part of larynx and skin."

"The clinical phenomena of avian gregarinous (coccidian) diphtheritis agrees in all particulars with those of bacterial

diphtheritis when these respective complaints affect the mucous membrane of the head. Here, also, the symptoms are essentially those of croupy diphtheritis of the mucous membrane of the mouth, pharnyx, air passages of the head, larynx, conjunctiva, etc., with secondary intestinal affections. Gregarines may also give rise to primary and independent enteritis (Zurn)."

"In gregarinous diphtheritis, the skin is much more frequently implicated than in diphtheritis caused by bacteria. The cutaneous affection consists of hypertrophied nodules on the skin, which are known as geravinous epitheliomata (*epithelioma gregarinosum* of Bollinger, and are identical *with molluscum contagiosum* of man.). Their favorite seats are those parts of the head that are not covered with feathers; root of the beak, neighborhoood of the nostrils, angles of the mouth, lobes of the ear, parts adjacent to the auditory meatus, wattles, surface of the face, edges of the eyelids, intermaxillary space, and especially the comb. They sometimes spread over the feathered parts of the head, throat and neck, and may occur on the outer surface of the thighs, abdomen, under the wings and in the vicinity of the cloaca. At first these epitheliomata appear in the skin, as flat uodules, which soon become prominent, and which vary in size from a poppy seed to a millet seed. Later on, they usually attain the size of a hemp seed. They are of a reddish-grey or yelllowish-grey color, often show distinctly in their earlier stages of development a peculiar greasy, nacreous lustre; and are rather firm to the touch. Their surface soon becomes covered with a dirty-grey, yellow-brown or red-brown crust. They are discrete and disseminated in considerable numbers on the erectile tissues, etc. They vary in size according to their age; and frequently lie rather close to one another, so that the affected parts looks as if coarsely granulated; or they are crowded together in such a manner as to give the appearance of large warts with divisions through them, or mulberry-like hypertrophies. Even single

nodules, to say nothing of groups, may attain the size of a lentil, pea, cherry-stone, broad bean or larger object. The older they become the rougher, and more covered with knobs will be their incrusted surface."

"If the edges of the eye-lids be affected by these tumors, the lids will become nodular, swollen and closed. The conjunctiva in this case also suffers; it projects outward; becomes catarrhally inflamed; assumes a yellowish color at the seat of eruption; and its surface becomse covered with crusts. Purulent conjunctivitis may appear and the inflammation may spread to the sclerotic and cornea, with keratitis and panophthalmia as the result. If, as sometimse happens with pigeons, the eruption of nodules extends over the whole of the skin of the eye-lids and its neighborhood, the entire eye will become covered with mulberry-like proliferations of various sizes.

COCCIDIA IN ANIMALS.

Coccidia (*C. oviforme* and *perforans*) have been reported as occuring in the following places in animals.

1. Leuckart (7) and many others have found coccidia in the bile ducts of rabbits there attacking the epithelium of the ducts, and in many cases causing the death ofthe rabbits.

2. Johne (8) and Ostertag (9) report coccidia in the liver of swine.

3. Birch-Hirschfeld (10) states that coccidia have been found "in the respiratory passages of rabbits, dogs, cats, calves, sheep, and birds, producing circumscribed or diffuse inflammation of the mucosa and submucosa, even superficial ulceration, which in many instances appears as infectious and results in numerous fatalities. He calls especial attention to the diphtheritic inflammation in the mucosa of fowl; its extension to the intestinal mucosa and the mesentaric lymph glands.

4. Ostertag (9) says *C, perforans* is found in the intestinal epithelia of rabbits producing a desquamative catarrh

of the entire intestinal tract and in consequence profuse diarrhœa.

5. Ostertag (9) also reports that in some of the Swiss cantons there is a disease called "dysenteria hæmorrhagica coccidiosa." The coccidia are found in the longitudinal folds of the mucous membrane of the colon and were oval or spherical and contained nuclei three times as large as those of epitheial cells. One observer says these are *C. oviforme.*

6. Ostertag (9) also reports *Coccidium tenellum* as an opizootic, croupous, diphtheritic enteritis in poultry and during the progresss of the disease or infestation the coccidia invade the mesenteric lymph glands producing disintegration foci.

7. Friedberger and Frohner (13) state that coccidia are very widely distributed as parasites in the animal kingdom and are found in birds, rabbits, rats, dogs, fish, snails, and earthworms. The diphtheritic products contain cast-off epithelial cells which contain in their interior a rounded body which fills up half or more of the cell-space and looks like a greatly enlarged nucleus. These bodies are highly refractive and have a greasy, glassy lustre, and swollen homogenous appearance. These spherical formations are also found free and in varying numbers in the croupy diphtheritic excretions of skin nodules in cocccidian diphtheria of chickens.

8. Moussu and Marotel (15) report coccidia in the intestines of sheep prducing hyperæmia and necrotic lesions in the mucosa.

9. Eckardt (16) found *Coccidium tennulum* in great numbers in the intestines of chickens, producing diarrhœa, great emaciation and intensely blue comb and wattles.

10. According to Nocard and Leclainche, (14) Rivolta, in 1869 found coccidia in the false membranes of diphtheria.

11. Thoma (18) says *C. perforans* has been reported as occurring in man, dogs, cats, rabbits and mice.

Coccidia (*Coccidium oviforme*) has been reported as occurring in the following diseases or conditions in man:

1. In the intestinal canal in two instances (2).

2. In *contagious epithelioma* (*molluscum contagiosum*) (1) a skin disease in man.

3. According to Leuckart (3) numerous cases of coccidia in the liver of man have been reported by Virchow, Dressler, Sattler, Peris, etc.

4. Padwyssozki (4) reports a case of extensive infestation of the liver of a man.

5. Peters (5) reports "ingekapselta gregarinen"—coccidia—in the diphtheritic membrane of six cases of diphtheria in man.

6. Leuckart (3) reports the records of Lindemann who found coccidia in the human kidney and also in one instance on the hair of the head of a young girl, where it was supposed to cause considerable irritation.

7. L. Pfeifer (6) reports coccidia in small-pox lymph.

The life history of coccidia has not been completely worked out. Johne, in Birch-Hirschfeld's book, (10) gives the characters and life history of *coccidium oviforme* as studied in rabbits, He says it is 0.03 to 0.037 Mm. long and 0.015 to 0.02 Mm. broad. The mature form consists at first, of the finely granular protoplasm which occupies the entire space in the cell (a fig. 5). In this stage the shell or wall of the cell may be quite thin but later it becomes thicker and apparently double contoured. In the next stage the protoplasm becomes contracted into a spherical granular mass (b fig. 5). In about four weeks (?) the proplasm is divided into 4 round granular spore-like bodies (c fig. 5) which later become the C-shaped bodies as observed in d. e. and f. in fig. 5. When these are taken into the stomach of a rabbit, the old capsule is dissolved and the spores or embryonic masses are set free and have amoebe-like movements and characters; in this condition they pass

from the intestine into the bile ducts where they penetrate the epithelial cells and develop into the stage (a) in fig. 5. In doing this they destroy the epithelial cells.

The following bacteria have been found in diphtheria, roup and sore-head in fowls:

Loeffler (26) in 1884 found a bacterium in diphtheria of pigeons and claimed that he produced the disease by inoculation with pure cultures of the germ.

Loir and Ducloux (27), Haushalter (28) and Quaranta (29) have found a bacillus or motile germ in the diphtheritic exudate of fowls.

Moore (25) in 1895 isolated from chicken diphtheria a bacterium belonging to the haemorrhagic septicaemia group. In later years he failed to find this germ in other outbreaks. Moore states that the real cause of diphtheria, roup and chicken-pox has not been discovered.

Cornil and Megin (30) in 1885 found a germ similar to Loeffler's bacterium in lesions of the mucous membrane and of the skin of fowls.

Von Krajewski (31) discovered the bacterium of Loeffler in the lesions of poultry and transmitted the disease to pigeons and young chickens by inoculation on the mucous membrane.

Babes e Puscarin (32) found the Loeffler germ in the diphtheria of pigeons and described its mode of action in the tissues.

Eberlein (33) in 1894 found a bacillus in the diphtheria of the partridge.

Harrison and Streit (21) discovered in the blood under the diphtheritic exudate of roup or diphtheria in chickens and pigeons a short motile germ (*Bacillus cacosmus*); and after passing the pure culture through pigeons to intensify its virulency, produced the disease in healthy chickens by inoculation. They also isolated the green pus germ (*Pseudomonas pyocyanae*) from the lesions in chickens and produced the disease by inoculation. Moreover they found

bodies in and among the epithelial cells of the exudates and tissues; these bodies may represent stages in coccidial life. They also found yeast cells in the diphtheritic exudates.

Gallez (34) isolated from the lesions in nasal mucuous membrane of chickens having contagious coryza (roup) a germ that he claimed was identical with the Klebs-Loeffler germ of human diphtheria.

Ferre (35) reports that he found the human diphtheria germ in the lesions of chicken diphtheria and he also found the germ on the mucous membranes of healthy chickens.

Gratia and Lienaux (36) isolated from diphtheritic pigeons a germ that closely resembles the human diphtheria microbe.

Harrison (23) made a number of tests with human diphtheria antitoxine and for the human diphtheria germ in chickens and pigeons and could not produce diphtheria in chickens by inoculating them with the human diphtheria germ. He also failed to find the germ of human diphtheria by examining over two hundred chickens affected with roup or diphtheria. He concludes that there is no relation between human and fowl diphtheria.

Guerin (37) makes a positive statement that there is no relation between human and avian diphtheria.

Moore, in his Pathology of Infectious Diseases of Animals gives the following records:

"The non-identity of these diseases (human and avian diphtheria) has been clearly pointed out by Menard (43). Although these maladies are shown by several observations to be unlike in their etiology and character of the lesions, the transmission of fowl diphtheria to the human species, and vice versa, is affirmed by several writers."

"Gerhardt (38) reports four cases of diptheria in Wesselhausen, Baden, among six workmen who had charge of several thousand fowls, many of which died of diphtheria. There were no other cases of diphtheria in the neighbor-

hood and the evidence was quit conclusive that the disease was contracted from the affected fowls."

"Debrie (39) reports briefly the transmission of human diphtheria to fowls. He is inclined to believe that human diphtheria is transmissible to fowls and fowl diphtheria to man. Cole (42) reports a case of supposed transmission of the disease from a fowl to a child."

"The diphtheritic disease of fowls reported by Loir and Ducloux (27) in Tunis, in 1894, spread to the people of that place, resulting in an epidemic of serious proportions. Menard (41) refers to the fact that men employed to feed young squabs contracted diphtheria by blowing the masticated food into the mouth and crop of squabs suffering with that disease. Schrevens (40) reports several cases of diphtheria in children in which he traces the sources of infection to certain poultry."

"Guerin (37) has pointed out with emphasis that there is no relation between diphtheria in man and in fowls."

Moore further states that until the relation between human and fowl diphtheria is positively determined it is wise to handle diseased fowls with care and especially keep all susceptible children away from diphtheritic chickens and pigeons.

M. Juliusberg (Deut. Med. Wochenschr, 30 (1904), No. 43, pp. 1576-1577), study of contagious epithelioma of pigeons and chickens is reviewed by Wilcox in the Experiment Station Record, for April, 1905, as follows:

"As a result of the study of the cause and symptoms of these diseases as well as the virus, it is found that the virus of pigeon-pox may be filtered in the same manner as the virus of chicken pox.

The incubation period of both pigeon and chicken pox after inoculation with filtered virus is about twice as long as after direct inoculation with the substance of the tumors (nodules or crusts). It was found that the repeated passage of the virus of pigeon-pox through animals

attenuated it to such an extent that it finally became non-virulent. The adddition of erythrosin in 1 per cent. solution destroyed the virus. None of the pure cultures of yeasts, cocci, or bacilli obtained from contagious epithelioma were found to be pathogenic for pigeons or chickens.

BACTERIA OBTAINED FROM SORE-HEAD CASES.

(a) Dec. 2 1903. Obtained following germ from crust of naturally infected chicken:

Long, round end bacillus, usually in filaments forms spores: 1.6 to 2.8 long and 0.5 micro-millimeters wide; slightly motile, flagella peritrichic; takes Gram's stain. Blood serum growth crumpled becoming mealy and greyish white.

Agar plate—growth on surface irregular, streaming and to naked eye appears like ground glass. Agar stroke is rugose, becoming mealy and grey-white. Gelatine liquified and pellicle on surface. Bouillon—at first a crumpled film; then mealy, flaky pellicle; flaky precipitate. Litmus milk coagulated and peptonized slowly. Gas is produced in lactose bouillon.

Potato growth is at first watery, and later becomes white crumpled and mealy.

This germ is closely related to bacillus subtilis. Inoculated a field lark with negative results.

(b). Dec. 6, 1903, obtained following germ from eye exudate of sore-head chicken:

Bacillus 1.5 to 2 times as long as broad. In old cultures it appears beaded. It is motile. Does not liquify gelatine; in gelatine stab the growth is filamentious; colony on surface has wavy edges and is finely granular. Colony on agar surface white, finely granular, edges even or slightly lobed; colony two-zoned. Hydrogen and carbon dioxide gas in glucose bouillon. No gas in sacchrose bouillon. Inoculated field lark by smearing scarified conjunctiva. Negative re-

sults. Inoculated chicken by smearing scarified conjunctiva—negative results.

(c). Germ from sore-head chicken, taken from blood under crust on comb. Oval or short rod with round ends; 1 to 1.6m long by 0.4 broad; and agar white round raised colony: does not take Gram's stain; motile with peritrichie flagella; forms irregular light grey growth on surface of litmus gelatine; does not liquify gelatine; on neutral agar light gray growth. On potato the growth is gray in 24 hours and later becomes brown. It decolorizes litmus milk and coagulates it. Produces gas in acid, lactose agar and increases the acid color.

Tested by smearing sacrified surface on chicken and by injection under skin. Negative results.

(d) Germ obtained from sore-head crust; coccus occurring in masses, sometimes single and sometimes short chains; growth on gelatine surface a wax-like yellow and very slight growth in depth. Gelatine not liquified; germ non-motile; takes Gram's stain; a lustrous yellow growth on blood serum. No gas in glucose, sacchrose or lactose bouillon. This germ was not tested by inoculation.

(e) Germ derived from crust of sore-head chicken. Large germ round ends; not motile; does not take Gram's stain; very slow growth in depth of gelatine at room temperature; in agar stab growth largely along depth of stab; slight brownish growth on blood serum; alkaline bouillon slight turbidity; acid bouillon heavy turbidity and precipitate at bottom of tube. This germ produces fermentation in glucose sacchrose and lactose bouillon. It may be a coli group germ or the *Bacterium aerogenes* of Escherich.

Inoculation of one chicken failed to give positive results.

(f) Obtained from crust of sore-head chicken, a coccus with following characters: It appears in two's, chains of six or eight and in masses; is motile and has one flagellum; it takes Gram's stain; yellow line growth from stroke on blood serum; milk not coagulated, yellow growth collects at

bottom; in bouillon yellow or white cloudy growth at bottom; colonies on agar surface produce diffuse cloudiness; does not liquify gelatine; on potato the growth is slow and yellow. Inoculated pigeons (b) and (c) with negative results This germ corresponds closely to Chester's description of *Planococous citreus.*

(g) Yeast.

(h) A streptococcus—negative results from inoculation.

(i) A germ that stained like a young culture of human diphtheria bacilli. Unable to transmit it by inoculation.

(j) *Pseudomonas pyocyanae.* Found quite common in all forms of sore-head, roup and avian diphtheria.

(k) Molds of various kinds are often found in sore-head crusts.

INOCULATION TESTS.

Inoculation tests with Pseudomonas pyocyanae, other germs, and exudate from natural cases of sore-head.

1. Brown chick, 3 months old. December 1, scraped rose comb and left wattle ; then rubbed into raw places green pus germ (pure culture from sore-head case).

December 8—Very slight indications of the inoculation taking hold.

December 15—Distinct thickening of skin on comb.

December 25—Well developed sore-head growth on comb.

2. Gray chick, 3 months old. Injected December 15 aqueous suspension of some green pus germ into left wattle and into comb.

December 25—Fairly good case of sore-head on comb.

3. Hen, 1 to 2 years old. Injected 1cc of acid bouillon culture of green pus germ under skin of head and into wattle. No appreciable effects.

4. January 17, 1903. Brown chick, 5 months old. Inoculated by scarifying comb and injecting under skin with a big coccus obtained from Adam's sore-head rooster. Result negative.

January 17, 1903. Injected under skin in 4 places and into comb of young chick a short thick bacterium from

Adam's cock. Chick died January 20. Liver, kidneys, intestines, lungs, all contained the germ (septicaemia). This germ was a short bacterium that coagulates milk; does not liquify gelatine and forms white growth on surface and a villous growth along the gelatine stab; white. even cloudy, growth on surface of agar; white, watery, glistening growth on potato; white even surface growth on Loeffler's blood serum. In neutral bouillon, it gave a thin film on the surface and slight turbidity; a granular growth formed finally at the bottom of the tube.

5. Oct. 3. Scarified inner surface of eye-lid of hen and smeared over this *streptococci* obtained from sore-head case. Negative results.

6. Feb. 2, 1903. Black chick 5 months old inoculated with a coccus and a mould obtained from sore-head case. Injected the coccus and mold under skin below the eye and into the base of the comb; chick died February 6 of septicaemia without showing any signs of sore-head.

7. Dec. 1. Inoculated *cockerel*, 16 *months old*, in right wattle with 1-4 cc of big bacillus (bouillon culture). No results from this. At same time rubbed in pseudomonas pyocyanae on sacrified comb.

Dec. 4. The comb above the scarified place showed red and swollen papillœ and skin at base of papillæ was yellowish green.

Dec. 10. One tooth of the single comb slightly involved.

Dec. 15. Digit or tooth on comb still involved and other teeth or digits of comb appear slightly involved.

Dec. 30. Scab came off and comb recovered.

Jan. 12. Scarified side of comb and rubbed in material from fresh natural case of sore-head—no results beyond the effects of scarification.

8. Post-mortem on chicken (4 mos. old) died of sore-head; it had small white diphtheritic patches in mouth, pharynx, oesophagus and larynx. Had been sick 10 days. Body light and very poor. Indications of diarrhoea by

soft feces covering feathers below the anus. Crust on comb, wattles, skin of head and on eye-lids, and in corners of mouth. Yellowish exudate in conjunctival sac larger than eye-ball, cornea partly destroyed and whole eye inflamed. Plate cultures from the eye exudate gave a large bacillus apparently *bacillus subtilis; micrococcus albus* and a germ that liquifies loefflers blood serum and stain like the human diphtheria germ showing the beading. But this germ from cultures did not produce any form of the disease by smearing over scarified surfaees of skin, comb, eye-lid and mouth.

Archibald R. Ward (20) makes the following records:

Inoculated 17 cockerels with solid or semi-solid exudates applied to broken skin of head. Only one developed sorehead. Four out of the 17 developed nasal discharges resembling roup. The same case that showed sore-head developed diphtheritic lesions (not stated where). One case developed nasal (roup) discharge by exposure to another chicken in same cage. This would seem to indicate that roup, sore-head and diphtheria in some cases were associated in the same chicken or that the causes of these so-called diseases were sometimes found in one chicken. Ward has proven that faulty ventilation or exposure to draughts in California does not cause roup or sore-head.

INOCULATIONS OF PIGEONS WITH GERMS AND MATERIAL FROM SORE-HEAD IN CHICKENS.

(a) Inoculated pigeon with bacillus from blood obtained of a sore-head chicken. Blood taken from directly under sore-head crust. Hanging dop showed almost pure culture of short oval, motile germ. Blood was injected and injected under skin of head with Planococcus citreus and smeared. This had no effect on pigeon.

(b) Pigeon smeared on scarified inner surface of eye-lid and injected under skin of head with planococccus citreus

obtained from sore-head case and cultivated in alkaline chicken bouillon. No results.

(c) Pigeon—Used the same germ as in (2) in the eye, the nose and under skin. No results.

(d) Oct. 18, 1905. Inoculated a pigeon with aqueous suspension of material from eye of sore-head chick. Injected material under skin of breast and smeared it over eye-lid. This material contained numerous green pus germs and a few micrococci.

October 31 this pigeon died. At point of inoculation was an abscess surrounded by characteristic green coloration of the green pus germ. Liver hyperæmic, also lungs and kidneys. Cocci in blood.

Oct. 31. Inoculated under skin another pigeon with blood from heart of above pigeon. Results negative.

TESTS WITH MOSQUITOES AS CARRIERS OF THE VIRUS.

(a) One Cockerel—Rhode Island Red.

Previously had one attack of nasal roup.

Two pigeons—grown.

Three grown hens.

Two chicks half grown.

One hen that had sore-head the year.

One young common cockerel.

All were exposed for three months from May 1 to August 1, 1905, to mosquitoes, (culex and stegomyia varieties). Rain barrels were kept close to the coops where numerous mosquitoes could be grown and easily get at the chickens. Not one case of sore-head. All kept in shed and the weather was quite damp and air very moist most of the time.

(b) Oct. 24, 1903, confined two hens and one rooster in a coop which was placed over a barrel of water from which mosquitoes were constantly hatching. Nov. 3 one hen had developed sore-head. All three of these chickens had a

naturally acquired case of sore-head the previous winter.

At the same time (Oct. 24) four chicks (one-half grown) were confined in another coop in same room, and on November 3, two (2) chicks developed sore-head.

These chickens and the barrel of water were all confined in a room, where green pus germs were plentiful and the germ was present in the water in which the mosquitoes were developed and also found in the sore-head lesions. The mosquitoes were not tested for the green pus germ.

(c). At my home in Auburn, a hen with six chicks kept her chicks at night under a dense growth of honeysuckle vines. Three out of the six chicks developed sore-head. This was in November and mosquitoes were quite numerous about the honeysuckle vine. Another hen had four chicks in a coop 100 feet away from this vine and they did not contract sore-head. The chicks of the two hens mingled more or less in the day time.

A lady in Texas has recently reported to me that she has found that roaches are the carriers or the cause of sore-head in chickens; that when she exterminated the roaches the sore head cases disappeared. This is by no means conclusive, but suggestive.

The CAUSE or CAUSES of avian diphtheria, roup and sore-head have not been definitely determined. It appears that Loeffler's Bacterium and Harrison's Bacillus cacosmus and the Pseudomonas pyocyanae have some claim as casual factors. But the records and tests do not seem to place any one of them as always the primary or real cause. There is much evidence that the real or primary cause is an ultra-microscopic organism and belongs to that group of disease-producing organisms which are classed with the causes of small pox, cow pox, sheep pox, contagious foot-and-mouth disease, possibly yellow fever and some other diseases.

According to Ward exposure to air draughts does not cause "roup" in California.

Transmission and Dissemenation.—It is evidently infectious; because the disease in all its forms, spread rather rapidly from one chicken or pigeon to another. Ward, Harrison and others have transmitted, in some cases quite readily by carrying small amount of diseased material (exudate and blood), from a sore-head chicken to healthy chickens. It is also, quite certain that chicken pox and pigeon pox are identical or one and the same disease.

Mosquitoes, gnat flies, chicken mites,(ticks)chicken lice, chicken foot mites (sarcoptes mutans) and possibly cockroaches may sometimes be the carriers of the real virus. It seems quite certain that mosquitoes can transmit the virus from water or some other source, under certain conditions. Warm and wet weather seems to increase the virulency of the virus and favor the rapid transmission of the disease. It is not impossible that ants may have a role to play in the transmission or cause of sorehead.

Pathological Anatomy.—On the skin the small, greasy-like nodules, or hypertrophied nodules of the skin, contain epithelial cells that have in them "greasy" refractive bodies that stain yellow with picro-carmine and the nuclei of the epithelial cells become "reddish brown" in color. Nearly all of the epithelial cells in the nodule appear larger than normal and contain the refractive bodies. In the younger epithelial cells these bodies (young coccidia?) are relatively small and occupy one-fourth to one-third of the epithelial cell cavity. In the older or outer or cast-off epithelial cells these refractive bodies are said by Friedberger and Frohner to occupy the entire cavities of the epithelial cells. The invaded or infested epithelial cells are unusually larger than the epidermal cells of the healthy neighboring skin. Among the cast-off mass of epithelial cells are found round refractive bodies and numerous nuclei of leucocytes or pus cells. The subcutaneous connective tissue is hyperaemic (congested) and is infiltrated with cells (leucocytes and nuclei of disintegrated cells).

Possibly some of the small nuclei-like bodies among the cells in the subcutis (see fig. 7) may represent one stage in the development of cocidia. Many observers have, also, found various bacteria in the nodule and subcutis.

In the diphtheritic membranes on the mucuous surfaces of the mouth, pharynx, larynx and oesophogus, the epithelial cells are sometimes invaded by refractive bodies in the same manner as the epithelial cells of the skin and in the mass of diphtheritic exudate and cast-off cells on the mucous surface may be found the well formed coccidia, usually in the stages (a) and (b) as indicated in fig. 5. But the refractive bodies are not found in the epithelial cells of mucuous exudates or of skin nodules in every case. I have found them only in the early development of the nodule and the diptheretic exudate, and have never found the mature coccidium in the nodules of the skin.

When the exudate on the mucuous surface or the crust of the nodule of the skin is torn off the raw surface bleeds rather freely and a fresh mount of this blood contains a short oval bacillus, numerous round bodies (see fig. 7.) usually said ti be nuclei of leucocytes; and a few polynuclear leucocytes. Repeated inoculations in the comb, wattles, skin and conjunctiva and oral mucuosa of healthy chickens of various ages, with this blood, fresh from under a nodule or a diphtheritic exudate, has failed to produce positive infective results. I have also tested it on pigeons with like negative results.

The exudates on the mucuous membrane of the throat mouth or larynx appear to be very much alike in all forms of the disease.

The CLINICAL SYMPTOMS of sore head are quite clearly described in the quotation from Friedberger and Frohner on page 23 of this bulletin. The crust-like nodules on the skin of the head, comb, wattles, and eye lids are quite common. The mucuous membrane (conjunctiva) of the eye may be involved and a large amount of tears or serum

and organized exudate fill the conjunctival sac or the cavity formed by the closure of the eye-lids. The cornea of the eye ball may become ulcerated and destroyed by pressure of the exudate and extension of the inflammation to the cornea. In some cases the entire eye ball may be destroyed by pressure of the exudate and inflammatory processes.

There may be croupy diphtheretic membranes in the mouth, pharynx, larynx, trachea and oesophogus; also in the nasal passages and air cells or cavities connected with these passages. When the larynx or trachea are affected there may be difficult breathing, as wheezing or rattling in the throat. When the nasal mucuosa is involved, a nasal mucuous discharge will appear; and when the lower orbital sinus becomes filled with semi-solid mass of pus, etc., a prominent swelling will appear under and around the eye; that half of the hard palate in the roof of the mouth becomes twice its usual width and bulges into the mouth cavity. At the first appearance of this enlargement, pressure on it may produce a discharge from the nostrils. At first this enlargement under and around the eye may be soft and if then opened will be found to contain quite a thick, pus-like liquid: but later the enlargement becomes hard, and if then opened is found to contain a mass of white or yellowish granular or flaky pus, more or less dry.

If the inflamed process has been progressing for sometime about the mouth, throat, etc., the infection may extend to the intestinal mucosa and there diphtheritic infiltration may appear attended by diarrhoea with watery, bad smelling feces, sometimes the feces becomes mucilaginous, or bloody. This usually causes stupor, dullness, depression and death. If the head only is involved, the affected chicken may retain its good appetite and general health and make a nice recovery in 10 to 20 days. In some badly affected cases of the nasal form (roup) the appetite will remain good, but the affected bird becomes gradually more and more emaciated.

The PERIOD OF INCUBATION is said to vary all the way from 2 to 20 days. In December I placed a newly-purchased barred Plymouth rock cock (18 mos. old) in a yard with my chickens, many of which were recovering from sore-head, and in 24 hours this cock developed a good case of sore-head on the wattles, comb and eye-lids. There were mosquitoes in the roosting house. The period of incubation varies with mode of transmission, virulency of the virus, the weather (rapid in damp warm weather and slower in cool and dry weather,) and the age and condition of the chicken or pigeon. Chicks from broiling size up to 7 or 8 months old seem to be most susceptible. Chickens with large combs seem to be more susceptible than birds with small combs and wattles.

Affected birds may recover in 2 to 8 weeks.

The mortality is said to vary from 50 to 70 per cent. of the affected birds. I judge this a low per cent. of losses if birds are left to themselves without proper care or treatment. But if individual treatment is patiently and regularly applied the mortality can be cut down to less than 20 per cent. If only the skin of the head, and the comb and the wattles are involved,one should lose less than 10 per cent. If the mouth and pharynx are also involved, less than ten per cent. should die. But if the nasal passages and infra-orbital sinus is filled with pus, or the larynx and trachea are involved, or the intestines become involved,—good care and treatment may save 50 to 80 per cent.

Immunity.—It is possible that one attack of sore head makes the bird insusceptible to a second attack. I have noticed that old chickens that have passed, at least two summers, are rarely affected and I have been unable to infect chickens that have had one attack of any form of the disease, except in a few cases.

Treatment.—Iodoform, creolin, lysol, creosote, carbolic acid, permanganate of potash, corrosive sub limate, chlorate of potash, chloride of lime, nitrate of silver, boric

acid, tincture of iodine, sulphate of copper, sulphate of iron, zinc sulphate, solicylic acid, and many other drugs have been recommended. It is possible that a number of the above drugs may be useful if properly applied. Friedberger and Frohner advise "the application by brush of a solution of corrosive sublimate (1 or 2 parts in 1,000 of water), or one of creolin (1 to 2 in 100 of water)." This they say is especially effective when the disease is localized.

I have found nothing better or more effective than iodoform by itself; or iodoform 1 part and tannic acid 1 part;or iodoform 1 part, boric acid 1 part and tannic acid one part. It is best to wash the head, wipe out the mouth and throat with a weak solution of creolin (1 or 2 to 100), using a boiled cotton or medicated absorbent cotton swab. Next remove the crust on the skin, comb, wattles and eye-lids and the exudate from the eyes, the mouth and throat. Then with sterilized or boiled or absorbent cotten wipe away the blood on the raw surfaces until they cease to bleed; then with cotton swab cover the raw places with iodoform or either of the iodoform powders above mentioned. Do not be afraid to put iodoform into the eye or the conjunctival sac. The next day or the same day a few hours later, apply freely vaseline or fresh lard all over these places. In some cases it may be necessary to apply the iodoform or iodoform powders once a day for two or three days, and thereafter apply freely only lard or vaseline every day. In other cases, one application of the iodoform and daily applications of lard and vaseline are all that is required. In bad cases, especially where they do not improve as rapidly as they should, give internally, as much as a teasponful of vaseline, containing a few drops of creosote, or 10 to 30 grains of Epsom Salts in 1 tablespoonful of water. This may be given once per day or once every other day; it usually prevents intestinal infection or complications.

In cases where "roup" predominates, or where the sub-orbital sinus becomes filled with pus and the eye is greatly dis-

tended,there are several lines of treatment that may be followed. In the early stages apply sweet oil or olive oil to the nostrils and if possible inject some of this oil into the nasal passages by using a small nozzle and syringe. After injecting or applying the oil, apply pressure over the distended parts and thus expel as much of the pus as possible. This may be repeated twice per day. Also in the early stages of roup, the diseased birds may be placed in a moderately tight room and there steamed in this way: Fill a large bucket or a kettle a little more than one-half full of hot water; now put into the bucket 1 tablespoonful of creolin and the same quantity of turpentine; then drop into the bucket a red hot iron, weighing 5 to 10 pounds. Let the affected chickens breathe this steam for 10 to 20 minutes. If the room is too small or too close, you might scald or suffocate the chickens; this can be prevented by regulating the entrance of fresh air at the door or windows. This may be repeated once per day, for a week or longer if it improves the condition of the birds.

When the distension is hard or firm, there is no way to remove the dry pus from the sub-orbital sinus except by opening the sinus.. This can be done by cutting into it below the lower eye-lid and parallel to the border of the lid; remove the pus: wash out with weak creolin or other disinfectant and stitch it up.

Chickens with affected eyes must be fed by hand.

Prevention.—No doubt, it can be introduced into a flock of birds by bringing in an affected bird, and this should always be avoided. But I have seen it appear on farms and in yards where no new birds had been introduced for 6 months or more. However, in such cases, pigeons or other wide ranging birds may have introduced it. Sore-head has occurred in Alabama,so widely extended as t embrace nearly every county, every year for the past 15 years. The cause or virus may live over from year to year or it may pass the winter in a second host. Isolation of sick from well birds

is advisable and wide ranges, dry, well ventilated and clean roosting houses will materially aid in checking the extension of the disease. The conditions that favor the propagation of mites, ticks, lice, mosquitoes and roaches are favorable to the extension and excessive virulency of sore-head in all its forms. Hence, old and filthy nests, damp, hot and filthy roosting houses; filthy and close brooding coops; poorly drained and small,, unclean yards; dirty water and filthy water and feed vessels; sour, fermenting, rotten, musty, or spoiled feed of any kind—should all be avoided; not only as means of preventing sore-head in all its forms, but also to help keep out all other infections and maintain the vigor and health of the flock. Cleaning, white-washing, spraying with disinfectants, should be practiced at least once per month during outbreaks of sore-head, and once every two or three months as wise and profitable sanitary and preventive measures.

Some of the Cases Treated.

1. Plymouth rock cockerel, 5 months old. Had several scabs on head. Removed the crusts once and applied vaseline every day. Recovered in two weeks.
2. Plymouth rock grade, 4 months old. Several crusts on head. Removed crusts once and applied vaseline and 5 per cent creolin. Recovered in 2 weeks.
3. White Leghorn hen, 2 years old: had sore-head crusts all over comb and large yellow exudate in eye. From the eye almost pure culture of *psendomonas pyacyanae* was obtained. Removed crusts from comb and exudate from eye: applied equal parts of iodoform and tannic acid to comb and put into eye. Repeated every day for three days ;then used vaseline every day. Recovered in 18 days.
4. Rhode Island Red cock, 1 year old. Had sorehead and eyes were distended from a collection of dry pus in suborbital cavities. In other words this cock had sore-head and roup. Applied vaseline to crusts on head and gave

vaseline per mouth, and tried to work it into nostrils. This cock recovered from skin sores on head and at times appeared to improve in the roup conditions in nasal sinuses. He never lost his appetite but was continualy poor or thin in flesh. He died or was killed one night by some animal.

5. Common hen with distended eyes from pus in one nasal sinus. Opened below eye and removed pus; washed with 3 per sent. creolin; stitched up; recovered in 10 days.
6. Light Bramah hen, 2 years old; head one mass of crusts; both eyes filled with exudate and closed. First removed crust from skin of head and exudate from eyes. Applied iodoform and tannic acid to the head and eyes, once per day for three days: then applied daily vaseline. Recovered in 18 days. Had to feed this hen by hand for several days until she could see to eat.
7. Common hen with crusts on head and diphtheritic exudate in mouth and throat. Removed the crusts from the head and exudates from the mouth and throat. This always leaves raw bleeding surfaces. Applied iodoform and tannic acid to raw surfaces. Repeated this for 4 days; then applied vaseline once each day, some days gave one-half teaspoonful of vaseline and a little 3 per cent creolin internally. This is done to destroy and eliminate germs or parasites that may pass into the alimentary canal when the throat and mouth are at first involved. This hen recovered in 15 days.
8. In flock of 75 White Bramahs and White Leghorns, a large number of the young chickens 2 to 8 months old and many of the old hens contracted "sore-head." The disease appeared in June and cases appeared among these chickens from that time until the last of August. Many of the chickens were very badly involved. The disease was confined usually to the skin of the head, to the eyes, the comb and wattles. A few cases had the mucosa involved and there diphtheritic exudates appeared. Quite a

number of cases developed nasal discharge. These cases were treated with vaseline. The crusts were removed and veseline applied. Thereafter vaseline was applied once per day for 3 or 4 days and then every other day. The exudate in the eyes mouth and throat was forcibly removed and vaseline applied freely. Ninety per cent. recovered.

9. In a brood of 9 chicks, hatched in October, when three weeks old, 6 of them developed sore-head and sore mouth. The eye-lids and the eyes (conjunctival sac) and the mouth and throat were involved. In this case the chicks had what is usually called sore-head with sore mouth or diphtheria of mouth and throat. This combination is not uncommon. In fact nearly every case of chicken pox or sore-head has sore-mouth in some form and also some discharge from the nasal openings indicating the presence of "roup." These chicks were treated with iodoform and tannic acid once per day for 3 days and then pure fresh lard was applied daily. All but one recovered in three weeks.
10. In large number of White Leghorns sore-head and distended eyes from roup exudate in nasal passages appeared. Nearly all died where the dried exudate collected in nasal passages but large per cent. of the cases of sore-head recovered by removing the crusts and applying fresh lard.
11. One man reports trying "Mercurial Ointment" on sore-head chickens and that it failed to cure them.

References:

(1) Bollinger.—Tagebl. d. Vers. D. Naturf u. Aerzte. Cassel. 1878.

(2) Von Eimer.—Ueber ei und kugel- formige Psorospermien der Wirbel thiere, Wurzburg, 1870.

(3) Leuckart.—Menschliche Parasiten, Erster band 1863; p. 740.

(4) Podwyssozki.—Centralbl. f. Bakleriotologie. u. Parasitenk, 1889, 21.

(5) Peters.—Berl. klin. Wachenschr, 1888, 21.
(6) Pfeifer, L.—Zeitschr. fur Hyg. II u III 1888 Monatsch. f. Dermatol. VI 10.
(7) Leuckart; Reick, Deutsche Zeitschr. f. Thiermed, XIV 52.
(8) Johne; Ber. uber. d. Vet. W. im K. Sachsen 1882, S, 60.
(9) Ostertag.—Wilcox; Handbook of Meat Inspection, p. 521.
(10) Birsch-Hirschfeld, Lehrbuch der Algemeinen path, Anatomie, pages 370 to 284.
(11) Neumann.—Parisites and Parasitic Diseases of Domestic Animals, p.264 and p. 341.
(12) Bollinger.—Epithelioma contagiousum bein Haushuhn und die sog. Pocken des geflugels, in Virchows Archiv, f. Path. Anat. Bd. LVIII 1873, p. 349.
(13) Friedberger and Frohner (Hayes transl.) Veterinary Pathology, Vol. I, p. 222 to 235.
(14) Nocard et Le clainche, Les Maladies Microbiennes des animaux, 1902 p. 252.
(15) Moussu and Marotel, Bulletin de la Societie de Med. Veter 1901. Dec. 31. Reported in Centralb. f. Bak. und Parasitenk, 1902.
(16) Eckardt.—Urber coccidiosus intestinalis biem Geflugel, in Berliner tierarztl, Wochenschr, 1903. No. 11.
(17) Metzner.—Untersuchungen on *Coccidium cuniculi Arch. f. Parasitenkunde, Bd. II.* 1903, *p.* 13.
(18) Thoma.—Pathology and Pathological Anatomy, Vol. I, p. 132; 1896.
(19) Ward.—Poultry Diseases in California. Proceedings of Am. Vet. Med. Association 1904. p. 164.
(20) Ward.—Observations on Roup in Chicken. Proceedings of Am. Vet. Association 1905, p. 198.
(21) Harrison and Streit.—Roup, Am. Vet. Review, Vol. XXVII, 1903, p. 26.
(22) Harrison and Streit.—Roup: An experimental study.

Bulletin 132. Ontario Agric. Coll. and Ex. Farm 1903.

(23) Harrison.—The Supposed Identity of Human and Avian Diphtheria. Re-print (in pamphlet) from the proceedings of the Thirtieth Annual Meeting of American Public Health Association, 1902.

(24) Mack.—The Etiology and Morbid Anatomy of Diphtheria in chickens, Am. Vet. Rev., Jan., 1905.

(25) Moore.—A preliminary investigation of diphtheria in fowls. Bul. No. 8, U. S. Bureau of An. Ind., 1895.

(26) Loeffler.—*Ueber* die Bedeutung der mikroorganismen f. der Entstehung der Diphtheria biem Menschen, bie der 'Tauben und biem Kalba.—Mitthiel, des kaiserl. Gesundheitsamtes, t II 1884, p. 421.

(27) Loir et Duclaux.—La diphterie avaire en Tunise—Ann de l'Institut Pasteur 1894. p. 599.

(28) Haushalter.—Notes sur la dipterie aviare—Rev. Med. de l'est, t. XXIII, 1891. p. 289.

(29) Quaranta.—Sulla dipterite aviaria in sapporto cella dipterite umana. Nota prima, Torino 1897.

(30) Cornil et Megin.—Memoire sur la tuberculose et la dipterie chez les gallinaces, Journal de l'anatomie t. XXI, 1885, p. 268.

(31) Von Krajewski.—Ueber die Diphterie des Hausgeflugels, Deut. Zertschr. f. Thiermed. band. XIII, 1887.

(32) Babes and Puscarin.—Untersuchungen uber die Diphterie der Tauben Zeitschrift fur Hyg. band. VIII, 1890, p. 376.

(33) Eberlein.—Geflugeldiphterie bei Rebhuhnern. Monatshefte fur Thierheilk, 1894, p. 433.

(34) Gallez.—Diphterie Animale et diphterie humaine, Annales de Med. Veter, 1895, p. 309.

(35) Ferre.—Diphterie humaine et diphterie aviaire. Congres d'hygiene de Madrid, 1898.

(36) Gratia et Lienaux.—Contribution a l'etude bactereologique de la dipterie aviaire. Annales de Med. Vet. 1898, p. 401.

(37) Guerin.—Sur la non-identite de la diphtheria humaine et de la dipterie aviare, Recueil de Med. Vet. 1903, p. 20 (from Moore.)

(38) Gerhardt.—Revue f Thierheilk, und Viehzucht, Bd. VI, p. 180, (from Moore).

(39) Debrie.—Reported in Centrabl, f. Bak, und Parise tenk, Bd. XIII, p. 730. (From Moore, Pathology of Infect. Diseases of Animals).

(40) Schrevens.—Bulletin de l'Acad. Royale de Med. de Belgique. Vol. VIII. (1894). p. 380 (Moore).

(41) Menard.—Revue d'Hygiene t, XII (1890). p. 410, (Moore).

(42) Cole.—Archives of Pedriatics, XI, 1894, p. 381. (Moore).

(43) Luggar.—Minnesota Experiment Station Bulletin Insects injurious in 1896. Page 91. (Sarcoptes mutans on comb and wattles).

(44) Sedwick.—Chickens and their diseases in Hawaii, Bul. No. 1, Hawaii Agricultural Expt. Station, 1901.

(45) Salmon.—Diseases of Poultry.

EXPLANATION OF PLATES.

Fig. 1—Sore-head crusts on comb, eyelids and skin.

Fig. 2.—Head of hen that recovered from bad case of sore-head. The bare places on the skin around the eye give some idea of the extent of the crusts. This case was treated with creolin and vaseline.

Fig. 3.—A case of sore-head with eyes badly involved and a large diphtheritic ulcer with prominent exudate on roof of mouth or hard palate.

Fig. 4.—Same case as fig. 3 with mouth opened to show the exudate on hard palate.

Fig. 5.—(By Johne in Birch-Hirschfeld's Pathological Anatomy). It represents the stages in the life history of coccidia. See description on page 27.

Fig. 6.—Shows epithelial cells of the skin from sore-head case. The coccidia are supposed to enter the epithelial cell and destroy its contents or take the place of the body of the epithelial cells.

Fig. 7.—Illustrates the cells found in blood taken from immediately under a sore-head crust. rbc. are nucelated red blood cells. wbc. are white blood cells or leucocytes. sf. are the nuceli of white blood cells or are free "sporozoits" or a free spore-like stage of coccidia.

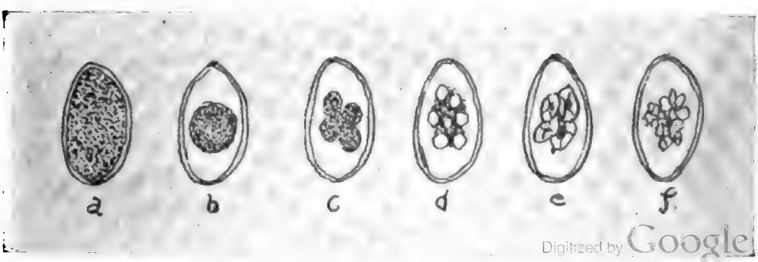
Fig. 8.—Section of the mucous membrane of pharynx of chicken. d. is the diphtheritic exudate (early stage) containing coccidia. m. is the mucuous membrane. mg. are mucuous glands.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.



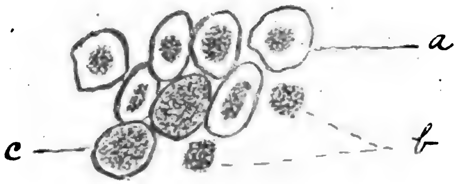


Fig. 6.

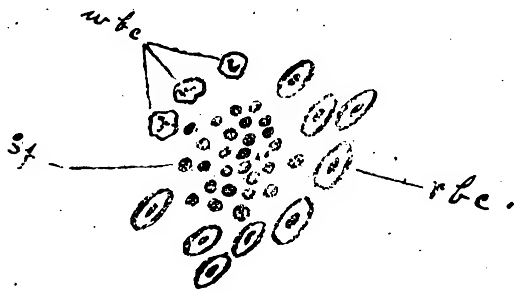


Fig. 7.

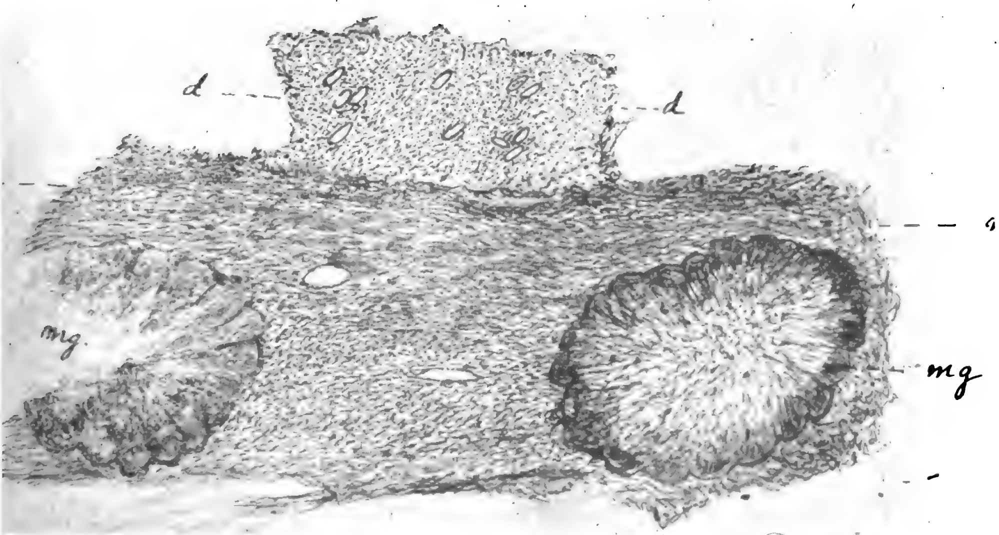


Fig. 8.

APPENDIX.

A few words on sanitary conditions in the poultry business may help some poultrymen out of difficulties.

The *water supply* for poultry should be the very best. Fresh water in clean, uncontaminated vessels should be kept constantly within reach of the chickens, or all kinds of poultry, especially during the hot weather. Good well water is preferable to running surface water. Protected earthen-ware vessels, or any form of water vessel, should be so constructed that it can be cleaned. In fact it should be cleaned daily with boiling hot water.

The *Feed* is responsible for the health, growth and flesh of poultry. Young chicks are often over-fed and usually fed in filthy places or in unclean troughs or vessels. More young chicks die from over-feeding, and sour, fermenting, discomposing feed than from any other cause. Especially is this true where mashes or liquid or moist feed is used. Some poultrymen use milk with bread or coarse meal in it. Milk is a good food; but if given to chickens it must be fresh or it should be boiled or cooked with the bread or meal in it, and fed as soon as sufficiently cooled. Always feed it in clean vessels, not in too large quantities and never leave the excess to sour. In feeding milk and all forms of moist feeds to chickens be sure to thoroughly clean and boil or scald out the feeding vessels once or twice per day during hot weather. Look well to the chick feeds. Many of them are made of refuse corn, wheat sorghum and other grains. As a rule it is best to make your own mixed grain feeds and then you will know the quality of each grain ingredient and will not be compelled to pay grain prices for the heavy grit that is so plentiful in the average mixed chicken feed. It is cheapest and safest and best for the health and growth of the chickens or other fowls to buy the separate grains and the grit and do your own mixing.

The chicken houses should be separated from all other

buildings and all the sides should be of lattice work or quite open during the summer; the north. east and west may be closed during late fall and winter. The floors, roosts and nests should be so arranged as to be readily removed, cleaned and disinfected. Portable or movable chicken houses are useful if so built that they will not come to pieces when moved. In case of infection with disease germs or of infestation with mites, intestinal parasites. lice, etc.. it makes the work of disinfection and eradication of parasites more easily and quickly and permanently done, if the house can be quickly moved to a new uninfected locality.

Most chicken coops are too close, too heavy and too inconvenient to clean. Some one should invent a "knock-down" brooding coop that can be cleaned readily and one that will not easily break and retain firmness and solidity when set up.

The yards and runs are usually too small and insufficient in number. Poultrymen can greatly lessen their work by having large runs or yards and many of them.

The placing of 20 to 40 chickens in a small yard (say 50 x 100 feet) and keeping them there 8 to 12 months in a year is one of the means of intensifying the propagation of intestinal parasites of all kinds. The degree of infestation of a yard or run or poultry house depends upon the size the number of poultry kept in them; the length of time poultry are kept in them; and, to some extent, on weather conditions. A large area, as a yard or pen, will not become alarmingly infested with intestinal or other parasites as quickly as a small area. Likewise, the fewer the birds and the shorter the time the birds are kept in a given place, the less, in degree, the infestation. This often explains why a man with very few chickens having good feed and wide range, can raise fine, healthy birds. But when this same man attempts to raise a large number on a small range, yard or run, he fails and his chickens are less vigorous or

healthy and consequently less profitable. The number of houses, coops, yards and runs should always be in excess of the immediate demands. Suppose a man has yards, runs, houses and coops for 3 different lots of chickens. He should at least have 3 extra yards and runs into which he could shift the disinfected houses coops and birds as soon as the the other yards or runs became infested. It would be best to have yards and runs sufficient in number to enable the poultryman to make three or four shifts before coming around or back to the first. This may seem extravagant but it is the only means by which you can breed healthy, vigorous birds without an immense outlay in cleaning and disinfecting yards or runs. Immediately after vacating a yard or run, plow it up and seed it down to wheat, rye, oats, barley, cowpeas, sorghum or anything that will make a growth upon which the chickens can graze when brought back to this yard or run. Young chicks should not be allowed to range over ground where old chickens run; if it be possible, have the young chicks in a run or yard where no old chickens have been for 6 or 8 months. This will prevent young chicks from becoming infested with round worms and tape worms.

In purchasing a new chicken, or a new lot of chickens, have them confined in some place remote from the flock for one to four weeks. During this time you will determine the presence or absence of such an infectious disease as fowl cholera. This precaution may save your flock and the difficulty of disinfecting houses and yards.

Chicken mites are the most common pests in nests and houses. Cleanliness is the best means of preventing their multiplication. They developed best in filthy nests and in cracks and under boards in chicken house. Clean the house (move if portable) and then spray the house with kerosene oil emulsion. If possible apply tar in the cracks and under roosting boards and this will catch many which escape the spray. Clean and spray the infested houses and coops

once per week and dip the infested chickens in weak kerosene oil emulsion, or a 2 to 4 per cent creolin solution. Never dip chickens in a poorly mixed kerosene solution. It will blister the skin, if the kerosene is not thoroughly emulsisified. The copper sulphate solution if applied hot will kill mites. It should not be applied on the chickens.

Every farmer or poultryman in Alabama should take one or more good poultry journals, and get all the bulletins on poultry from the department of agriculture at Washington, D. C., and the bulletins on poultry published by the state experiment station and also secure Salmon's book on Poultry Diseases. Please report to me all the outbreaks of poultry or other infectious animal diseases that may occur in your vicinity or on your farm. Make these reports, at least once every year.

Kerosene oil emulsion is made as follows:

Dissolve 1-2 pound of hard soap in one gallon of hot water; add 2 gallons of kerosene and stir or churn until a milky mixture (or emulsion) is formed: now add 8 to 10 gallons of water; stir or mix with a spray pump, or keep the first emulsion of soap, water and kerosene and use as much of it as you desire after diluting with 8 to 10 parts of water.

Copper Sulphate Solution.—Dissolve 4 to 6 pounds of copper sulphate (blue stone) in 20 to 50 gallons of water. Spray this over dusted or cleaned boards, walls, nests or other places. When dry, or the next day, whitewash with spray or brush. If applied hot this copper sulphate solution will kill mites.

Government White Wash.—"Half a bushel of unslaked lime, slaked with warm water. Cover it during the process to keep the steam. Strain the liquid through a fine siene or strainer. Add a peck of salt previously well dissolved in warm water, three pounds of ground rice boiled to a thin paste and stir in boiling hot a half pound of powdered Spanish whiting (Plaster of Paris) and a pound of glue

which has been previously dissolved over a slow fire, and add five gallons of hot water to the mixture. Stir well and let it stand for a few days. Cover up from dirt. It should be put on hot. One pint of the mixture will cover a square yard if properly applied. Small brushes are best. There is nothing that compares with it for outside or inside work and it retains its brilliancy for many years. Coloring may be put into it and made of any shade, Spanish brown, yellow or common clay."

This is good for chicken houses, etc.,to fill up small cracks and make a smooth surface. To it may be added two pints of carbolic acid, which will make it a disinfectant.

List of a few drugs and their uses for the poultryman:

For Intestinal Worms:

1. Isolate infested birds and destroy or disinfect their droppings while being treated.
2. Put one to 2 drams of copper sulphate in each gallon of drinking water, for one week: or
3. Powered Pomganate root bark (for tape worms) followed by 2 or 3 tablespoonfuls of castor oil: or
4. Oil of turpentine, 1 to 2 teaspoonfuls, followed in 4 to 6 hours with castor oil.
5. Powdered santonin in 5 to 8 grain doses is especially good for round worms.
6. Chopped-up pumpkin seed for tape worms.

For worms in the air passages:

1. Turpentine introduced by stripped feather, into the windpipe.
2. Steaming with creolin and turpentine in the hot water.
3. Feeding garlic in the food.

For Diarrhoea:

1. Subcarbonate of Bismuth. 1 to 4 grains. 2 to 3 times per day; or
2. Pulv. cinchona bark. 1 to 2 grains 3 times per day and
3. Quinine 1-8 to 1-2 grain 2 times a day.
4. Dry feed or cooked and slightly moist feed.

Constipation:

1. Epsom Salts.—20 to 30 grains in 1 tablespoonful of water; or
2. Castor oil, 1 to 2 teaspoonfuls; or
3. Calomel, 1 to 2 grains; and
4. Soft feed.

For Lice:

1. Lard,or vaseline over head, under wings and around anus.
2. Dipping in 15 per cent. kerosene oil emulsion; or
3. Dipping in 2 to 5 per cent creolin solution.
4. Pyrethrum powder dusted among the feathers.
5. Clean nests yards and houses.

For intestinal disinfectant:

1. One-half to 2 drams of copper sulphate in one gallon of drinking water; or
2. One-half to 2 drams of iron sulphate in 1 gallon of drinking water; or
3. Salol 1-2 to 1 grain, once or twice daily.
4. Napthol 1-2 to 1 grain, once per day after eating.
5. Resorcin 1-4 to 1-2 grain once per day after eating
6. Hyposulphite soda, 4 to 10 grains in one tablespoonful of water

FOR CHICKEN MITES.

1. Lard or vaseline on legs, feet and head applied once or twice per week. Wash off scales.
2. Kerosene Emulsion sprayed on walls, roosts, floors and nests once per week for what is commonly called chicken mites or chicken ticks.
3. Two to 5 per cent creolin solution sprayed on same places as (2).
4. Formalin 1 part to 200 parts of water sprayed as (2).
5. Corrosive sublimate (very poisonous) 1 part to 1000 parts of water sprayed as (2).
6. Boiling hot water freely applied by pouring over walls, roots, nests and floor.
7. Clean Chicken house every day until mites are gone.

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ALABAMA
Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

Experiments With Oats

By

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Director

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EXPERIMENT WITH OATS

By

J. F. DUGGAR.

SUMMARY.

Experiments extending over a period of ten years are summarized in this bulletin.

The oat may be made a much more profitable crop in Alabama than it now is, provided farmers will make the two following innovations in the usual method of caring for the crop; (1) Sowing in the early or middle fall. (2) Applying nitrate of soda as a top dressing in March, or sowing on land where a soil-improving crop like cow peas has recently grown.

In tests of varieties extending over a number of years there was little difference in the yields of Red Rust Proof, Appler, and Culberson when sown in the fall. These three varieties are practically identical.

When sown after Christmas the Burt or May oats averaged 7 per cent. less grain than did the Red Rust proof variety.

Turf or Grazing oats sown in November afforded only 59 per cent. as much grain as Red Rust Proof oats sown at the same time. The order of ripening of the principal varieties sown in the fall was Burt, Red Rust Proof, and Turf.

Red Rust Proof oats may be distinguished from other varieties usually grown in the South by the long beards which are usually present on both grains, by the brownish yellow color, by the plumpness of the grain, and still more positively by the greater length of the tiny hairs or bristles located at the base of the lower grain.

Red Rust Proof and related varieties or strains, Appler and Culberson, constitute the best general-purpose type of oats for this region, being suitable for either fall or February sowing, and having stiffer straw and greater rust-resistance than any other variety tested.

The Burt oat, (synonym May oat), is chiefly valuable for its earliness, and hence for sowing at a rather late date in spring. When sown in November it was almost completely winter killed in the severe winter of 1904-5, but it was uninjured during the mild winter of 1905-6.

Winter killing of oats may be greatly reduced and the crop almost insured against ordinary winters by using one or more of the following methods:

(1) Sowing in deep drills.

(2) Sowing in October.

(3) Sowing with a grain drill.

(4) Use of a roller after the plants have been heaved and their roots exposed.

(5) The use of Turf oats in the northern part of the cotton belt.

The average of seven experiments made in seven different years shows that Red oats sown in November averaged 11.3 bushels per acre more than when sown in February. This is a profit of $5.65 per acre, or an increase of 73 per cent. as the result of sowing in the fall. October is advised for fall sowing, and the first few days in February for spring sowing in this latitude.

Oats sown in deep furrows, about two feet apart, yielded more than broadcast sowing, the increase being 3.2 bushels per acre when the deep furrows were only partly filled, and 2.3 bushels when the furrows were almost completely filled. Planting in deep furrows only partially filled is recommended only for well-drained soils.

Smut of oats can be entirely prevented by moistening the

seed in a mixture of one ounce of formalin and three gallons of water.

Nitrogenous fertilizers have been much more profitable than phosphate or potash on the sandy and loamy soils at Auburn, but it is recommended that on such soils at least 100 pounds of acid phosphate be applied at the time of sowing oats.

Among the various nitrogenous fertilizers a pound of nitrogen or a dollar of investment has been most effective in nitrate of soda, and somewhat more effective in the form of cotton seed meal than of cotton seed. When either cotton seed or cotton seed meal is used it should be applied at the time of sowing, but nitrate of soda is most useful when used in March after growth begins.

Barnyard manure greatly increased the yield of the crop of oats to which it was applied, and exerted some effect on the next crop. In one experiment it required 43.1 pounds of nitrate of soda and 103 pounds of acid phosphate (costing together $1.93) to afford the same increase as one ton of fine, fresh, unleached horse manure.

In thirteen experiments with nitrate of soda the yield and total profit per acre increased with the amount of nitrate applied up to 200 pounds per acre. However, the smaller applications were more economical. The cost of nitrate of soda required to produce one additional bushel of oats was 14.5 cents from the use of 63 pounds per acre; 17.7 cents when nitrate was applied at the rate of 100 pounds, and 21.1 cents when 200 pounds of nitrate of soda was used per acre. The smallest application afforded a profit over the cost of fertilizer of 249 per cent.; the use of 100 pounds of nitate per acre returned a profit of 206 per cent. on the cost of the fertilizer, while the heaviest application resulted in a net profit of 140 per cent. The three different amounts of nitrate of soda gave profits per acre of $4.73 for the light application, $6.19 for the 100-

pound application, and $8.40 for the 200-pound application. Sixty to 100 pounds of nitrate of soda is recommended to be applied as a top dressing to oats in March.

No nitrogen need be purchased for oats, provided the oats be sown after a crop of cow peas, velvet beans, peanuts, or soy beans, all of which crops, whether only the stubble or the entire growth was plowed under for fertilizer, afforded an increase in the succeeding oat crop of from 6.2 to 33.6 bushels per acre. From 5 to 15 bushels increase in the succeeding oat crop is considered an average result of the use of the stubble or vines of leguminous crops employed as fertilizer.

THE OAT CROP OF ALABAMA.

Official estimates credit Alabama with only 197,787 acres of oats in 1904, as compared with 2,791,811 acres of corn. Is there any adequate reason why the farmers of Alabama should plant only one acre of oats for every fourteen acres of corn? For the ten-year period ending with 1904, the average yield of corn in Alabama was 12.7 bushels, and the average yield of oats was 13.9 bushels. Reducing both to pounds, we have a yield of 714 pounds of shelled corn and 445 pounds of threshed oats per acre.

The small production of oats per acre in Alabama would be a sufficient reason for the neglect of this crop were no improvement in yield practicable. However, it is a comparatively easy matter to double or treble this yield, and at very slight expense, as indicated in the experiments described in this bulletin.

In view of present and prospective agricultural conditions in Alabama there is urgent need for a very great extension of the area devoted to oats. A decreasing supply of labor calls for an increasing proportion of crops that, like oats, can be handled largely by machinery, and that require little labor per acre. The continual impoverishment of the soils of the Southern States argues for the more general in-

troduction of crops that will improve the soil. This improvement can be effected universally by the growing of cow peas, but most cotton farmers will not grow any considerable area of cow peas except on the land from which a crop of small grain has been harvested. Hence the extension of the culture of the small grains means an increase in the acreage of cow peas, soy beans, velvet beans, and peanuts, and hence the upbuilding of the soil.

YIELD OF OATS COMPARED WITH THAT OF CORN.

We have seen from a preceding paragraph that corn and oats average respectively in Alabama 714 and 445 pounds per acre. This comparison is scarcely fair to oats, for the reason that this crop is usually assigned to the poorest land on the farm, and is seldom fertilized. To ascertain the relative yields of oats and corn on adjacent plots, a careful study has been made of the results of an unpublished rotation experiment that has been in progress on the station farm at Auburn during the past ten years. We are able to make a satisfactory comparison for three years when all conditions of fertilization, season, and time of sowing were normal or identical for the two crops.

The average yield of oats from fall sowing (October 16 being the average date of sowing) was 24.6 bushels per acre, as compared with 13.8 bushels of corn planted April 6 to 8 each year. No nitrate of soda was used.

Reducing both crops to pounds of grain per acre we have 787 pounds of threshed oats and 772 pounds of shelled corn. This indicates that the yields under these conditions were practically identical in the following rotation:

1st year: Cotton.

2nd year: Corn, with cow peas between the rows.

3rd year: Fall sown Red oats, followed by cow peas.

In this rotation corn has a slightly more favorable position than oats, but this is doubtless offset by the fact that

the fertilizer used was not the one which affords the largest yield of oats.

In one experiment in which oats were compared with other small grains, all sown in the fall, the yields were as follows:

Oats versus wheat versus barley for hay and for grain in 1904.

CROP.	Yield per acre,		
	Unthreshed.	Grain.	
	Lbs.	*Lbs.*	*Bus.*
Alabama Blue Stem Wheat	2620	990	16.5
Red Rust Proof Oats....	1950	1150	36.0
Bearded Barley...........	1400	600	12.5
Culberson Oats........	1400	700	21.9

This shows a greater number of pounds of grain yielded by oats than by wheat or bearded barley. However, the weight of unthreshed grain and straw combined was greater with wheat, which indicates that wheat affords a larger yield of hay than does oats.

In a comparison of Red Rust Proof oats and Beardless barley both sown February 25, the yield of oats was 25 bushels (800 pounds) and of Beardless barley 18.7 bushels (880 pounds), the yield of barley being greater than we ordinarily secure.

VARIETIES.

While the list of varieties of oats grown in the Northern States and in Europe is a long one, there are but few kinds that thus far have proved suitable for the Gulf States. Our tests of varieties have been concerned almost entirely with the standard southern kinds, namely: **Red Rust Proof**, Appler, Culberson, Burt, and Turf or Winter Grazing oats. The first table that follows gives the yields of varieties sown in the fall. The average date of sowing has been November 14, which is too late for maximum yields, and especially much too late for the Turf oats. The next table gives the

yields resulting from sowing oats in February or March, the average date of these spring sowings being February 20, which is several weeks later than the date preferred by the writer for oats sown after Christmas.

The third table following is calculated from the other two and is the most important of the tables, giving the relative yields of varieties in terms of percentage and average results of experiments extending through a number of years.

Tests of varieties of oats sown at Auburn in the fall.

Variety	Per ct. Grain	Yield per acre	
		Straw	Grain
Sown Nov. 6, 1897		*Lbs.*	*Bus.*
Red Rust Proof	41.3	1,800	30.8
Hatchett's Black	38.7	1,057	20.8
Beardless Red	42.9	1,155	27.1
Early Siberian	28.5	1,129	13.9
Gray Winter or Turf	29.6	1,232	16.1
Deleware Winter	30.4	783	10.6
Sown Nov. 23, 1899.			
Red Rust Poof	48.6	869	13.5
Gray Winter or Turf	31.2	769	7.5
Hatchett's Black	45 9	675	14.0
Sown Nov. 13, 1903.			
Red Rust Proof	32.6	1,320	30.0
Appler	37.8	1,720	32.7
Culberson	38.3	1,440	28.0
Gray Winter or (Va. Gray)	32.5	1,400	21.0
Sown Nov. 10, 1904.			
*Red Rust Proof(spring strain)	44.4	1,120	28.0
*Appler	52.0	836	28.3
*Culberson	45.1	1,144	29.4
Sown Nov. 18, 1905.			
Appier	48.9	2,080	52.6
Burt	37.4	2,784	52.0
Culberson	45.7	2,088	48.0
Red Rust Proof (fall strain)	47.7	1,974	48.4
Sown Nov. 14, 1905.			
Burt (av.fall and spring strains)	44.9	1,784	46.1
May	46.9	1,880	51.9
Red Rust Proof (av. fall and spring strains)	46.8	1,575	58.2

*Partly winter killed.

Tests of varieties of oats sown at Auburn in the spring.

Variety.	Percent Grain.	YIELD PER ACRE Straw	Grain
Sown Feb. 17, 1898.		*Lbs.*	*Bus.*
May	39.9	1,790	35.9
Burt	41.7	1,658	41.4
Gray Winter or Turf	20.0	690	5.5
Red Rust Proof	42.9	1,276	30.6
Sown Mar. 7, 1902.			
Burt	27.6	616	7.3
Culberson	43.1	620	14.7
May	47.1	370	10.3
Red Rust Proot	33.6	870	13.7
Sown Feb. 5, 1903.			
Burt	25.7	896	9.7
Culberson	34.3	557	9.1
May	40.9	605	13.1
Red Rust Proof	33.3	880	13.7
Sown Feb. 23, 1905.			
Red Rust Proof	42.1	1,384	31.5
May	36.4	1,929	35.0

Relative yields of grain of varieties of oats at Auburn, taking yield of Red Rust Proof oats as 100.

	1898	1900	1902	1903	1904	1905	1906**	190[illegible]**	Average
Sown in November.									
Red Rust Proof	100	100	....	....	100	100	100	100	100
Beardless Red	88	....	....	....	....	....	....	....	88
Appler	....	....	....	....	109	100	109	....	106
Culberson	....	....	....	....	*93	106	100	....	100
Early Siberian	45	....	....	....	....	....	....	....	45
Gray or Turf	52	56	....	....	70	....	....	....	59
Burt	....	....	....	....	....	....	108	78	93
May	....	....	....	....	....	....	....	81	81
Av. Burt and May	....	....	....	....	....	....	....	....	89
Hatchett's Black	68	104	....	....	....	....	....	....	86
Deleware Winter	31	....	....	....	....	....	....	....	31
Sown in February.									
Red Rust Proof	100	....	100	100	....	100	....		100
Burt	135	....	53	66	....	....	....	....	85
May	117	....	75	100	....	111	....	....	101
Av. Burt and May	....	....	....	....	....	....	....	....	93
Culberson	....	....	107	66	....	....	....	....	87
Gray or Turf	15	....	....	....	....	....	....	....	15

*Yield reduced by smut.

**Different fields and different dates of sowing.

The last table deserves careful study.

The variety Red Rust Proof, also known as Texas Rust Proof, Texas Red, and simply as Red oats, has in these tests, as usual, proved worthy of its position as the most popular or standard variety for the Gulf States. It has been relatively satisfactory whether sown in the spring or the fall, though fall sowing is decidedly preferable in the central and the southern parts of Alabama.

Appler, a selection from the Red Rust Proof, cannot be distinguished from its parent, but in the three tests made at Auburn, the Appler has afforded 6 per cent. more grain than the Red oat.

Culberson is also like Red oats in appearance of grain, and the yield when sown in the fall has averaged the same. With us it proved a little more hardy than the Red oat, a slightly larger proportion of the Culberson plants surviving the trying winter of 1904-5. It is apparently a strain of the Red Rust Proof variety. Both Culberson and Appler are at least equal in merit to the parent strain.

Winter Turf, also variously known as Gray Winter, Virginia Gray and Myers' Turf, has been relatively unproductive here, averaging only 59 per cent. as much grain as Red oats when sown as late as November 14, and apparently not equaling Red oats when sown at its proper season, September or October. Sown here in the spring, the Turf oat is an entire failure. It ripens about two weeks later than Red oats sown at the same date, and hence is especially liable to fail to fill out well, either because of rust or of drought. This oat is only to be considered for grazing or hay, or for grain on the very best land, or in those localities in the northern part of the cotton belt where Red oats are usually winter killed. It has been recommended as a good variety to sow for hay with hairy vetch, but this is only true on rich land, for on our poor sandy uplands at

Auburn, Turf oats do not throw up seed stems in time to support the slender vetch plants. Here we find that a beardless variety of wheat or the Red Rust Proof oat makes a more satisfactory combination with hairy vetch.

Burt and May are apparently the same variety, the latter being the local name near Auburn. This is a spring variety and is seldom sown in the fall; however, it passed without any winter killing whatsoever through the mild winter of 1905-6, and afforded an average yield of 89 per cent. as much grain as the Red oat. In the severe winter of 1904-5 only 5 or 10 per cent. of a stand survived from a sowing made November 10, 1904. When sown in the spring the grain yield of Burt or May oats averaged 93 per cent. of that of Red oats, some years the advantage being with one variety and some years with the other. It is generally believed that Burt can safely be sown later in the spring than Red oats, and while our sowing of March 7, 1902, does not support this opinion, yet the view seems reasonable and correct because of the quicker maturity and longer straw of the Burt.

DESCRIPTIONS OF STANDARD SOUTHERN VARIETIES OF OATS.

Red Rust Proof:—Plants medium height; straw large and strong; berries or "grain" bearded, beards borne on both grains in most spikelets; beards large and long, usually inserted low down on the larger grain, that is, half way between the base and the extreme tip, but nearer the tip on the small grain; color of berries yellowish-brown, darker near the base, and darkening on exposure to moisture. A characteristic of Red Rust Proof oats is the greater length of the slender bristles or hairs at the base of the spikelet (that is at the lower end of the larger grain), which bristles in other varieties commonly grown in the South are either wanting, or occur on only a few of the spikelets, or are shorter than on Red, Appler, and Culberson oats. The

grains are very large and very plump. This variety is sometimes attacked by rust, but is less injured by this disease than the other varieties tested.

Appler:—This is a selection from the Red Rust Proof oats, and most of the spikelets are not to be distinguished from the parent variety. As grown at Auburn in 1906 it was even less uniform than the Red, containing a large admixture of black grains and a considerable proportion of spikelets of which only the larger grain was bearded.

Culberson:—This appears to be a strain of Red oats. The straw is perhaps a little taller. The grains are strongly bearded, both grains being usually bearded. In color, size and plumpness the grain is not distinguishable from the Red oat. The bristles at the base of most spikelets are relatively long, as in Red oats.

All three of the above varieties, constituting the Red Rust Proof group, are decidedly mixed, or lacking in uniformity of grains, which indicates the need of breeding for pure strains, a work that this station now has in progress. In the Red Rust Proof group about half the weight of sheaf oats consists of straw and half of grain, though the proportion of straw exceeds this on rich land.

Burt:—The majority of spikelets bear one bearded and one beardless grain, but some are doubly bearded and a few entirely beardless. The grains are more slender than those of Red Rust Proof oats, of a paler cream or brownish-yellow color. Most spikelets have only short bristles, or none. The straw is taller and weaker than that of Red oats, and the date of ripening is earlier. This variety is tender and is adapted to spring sowing.

Turf:—This variety is beardless. The grains are slender, light cream or gray in color, of a lighter shade than Burt oats, and the two berries usually break apart in threshing. The percentage of grain is small, there being usually about twice as much straw as grain.

Since there are so few varieties of oats adapted to the Gulf States, it is important that some distinguishing marks be found by which Southern farmers may be able to identify seed oats of a few leading varieties. With this end in view careful examination has been made of the four most popular varieties in the South, and we have found what seems to be a means of positively distinguishing the seed of the Red Rust Proof group from the other well-known southern varieties. The greater plumpness of grain of the Red oats and the larger proportion of spikelets in which both grains are bearded will serve to separate the Red oat group. A still more positive indication that a sample of oats is the genuine Red Rust Proof is the presence of a bunch of fine hairs or bristles at the base of the lower grain and the *greater length* of some of these bristles in this variety than in other varieties in which bristles occur.

WINTER KILLING OF OATS.

Oat plants from sowings made in the fall are liable to be killed by cold weather at any date between December 1 and March 1 in the central part of Alabama. As illustrating the earliest and the latest dates on which severe winter killing has occurred within the memory and observation of the writer, I would say that March 1, 1890, was one of the coldest days of the winter, and oats growing on rich land, which had already thrown up tender seed stems, were entirely killed, while other plants at an earlier stage of growth were severely injured.

The earliest date recalled on which oats were injured was on December 15, 1901, when the temperature suddenly dropped below the freezing point, following a period of heavy rains. There were severe freezes at night and complete thawing during the day for nearly a week, thus affording extremely favorable conditions for the heaving and destruction of oat plants.

The lowest temperature ever recorded in Alabama, and

probably the most complete destruction of oats by cold was experienced in February, 1899, when on the station farm practically all Red oats were killed except near woods or protecting fences, where a part of a stand survived. That cold weather, during which the minimum temperature was —6 Fahrenheit, not only killed Red oats, but Turf oats as well.

The following precautions used singly or together will greatly reduce the danger of winter killing and practically insure in this latitude the survival of a fair stand of oats, except in unusually severe winters:

(1) Sowing the seed in deep drills not completely covered, as discussed in a later paragraph.

(2) Sowing in October so as to give the plants time to form a strong root system as an anchor before severe freezes occur.

(3) Sowing with a grain drill, which leaves the land slightly ridged and the plants close together, thus apparently furnishing a small amount of mutual protection.

(4) Passing a roller over a field on which the plants have been heaved and the white roots exposed by alternate freezes and thaws.

(5) The sowing of Turf oats, which are hardier than Red oats, but are not to be preferred where the Red oats ordinarily succeed.

Cold weather may kill oat plants in either of two ways, directly by the action of the cold on the foliage and crown or indirectly by the heaving or lifting effects of alternate freezes and thaws. The first method of prevention mentioned above is effective against both results of cold, but is chiefly useful in preventing heaving. The use of the roller just after a succession of freezes is intended to counteract the results of heaving, since the roller presses the exposed crowns into contact with the soil, thus favoring the development of new roots. We have repeatedly used this method

with good results. It should, however, be remembered that the use of the roller while the land is still wet may result in unduly compacting the surface.

Before deciding whether it is best to rely chiefly on fall sown or on spring sown oats it is worth while to recall how many complete failures due to winter killing and how many partial killings have occurred within one or two decades in any given locality. Applying this test to the fall sown Red Rust proof oats on the Station farm at Auburn we find that during the past eleven years there has been but one winter in which practically all red oats have been killed, namely in 1899. In 1902 in spite of the trying weather of the preceding December, a part of the oats on the Experiment Station farm afforded a fair yield. The winter of 1904-5 was perhaps the third most unfavorable year as regards winter killing. Although the stand was very much thinned, yet the yields of our variety plots that year averaged about 28 bushels per acre. It is believed that farmers overestimate the danger of winter killing of oats or the frequency with which the stand is reduced to a point where the yield would be less than with oats sown in the spring. This tendency is natural, since few have put in effect the above-mentioned measures that may be taken to reduce the amount and frequency of winter killing.

TIME TO SOW OATS.

A large proportion of the oats grown in Alabama are sown in February. While this may perhaps be considered necessary for Red and Burt oats in those parts of the state in which experience indicates that fall sown oats are usually winter killed, yet this is the wrong time to sow most fields of Red oats in the central and southern parts of the State. Our experience, which is partly tabulated below, indicates that the yield from fall sowing is far greater than from sowing Red oats after Christmas. In all the experi-

ments tabulated below the same amount of fertilizer was used for the February sowing as for the November sowing, and all conditions were equal except the date of putting the seed into the ground.

Average results of fall sown vs. spring sown oats.

DATE OF SOWING	Percent grain in sheaf oats	Yield of grain per acre	Yield of straw per acre	Increase of grain from fall sowing
Experiment No. 1.	*Percent.*	*Bus.*	*Lbs.*	*Bus.*
November 18, 1896	45	21.7	895	7.9
March 1, 1897	43	13.8	587	
Experiment No. 2.				
November 23, 1897	38	18.2	958	11.
February 9, 1898	47	6.4	228	
Experiment No. 3.				
November 26, 1897	43	23.8	994	9.7
February 9, 1898	51	14.1	440	
Experiment No. 4.				
November 13, 1902	40	27.2	1328	13.5
February 5, 1903	34	13.7	1024	
Ezberiment No. 5.				
November 19, 1903	57	15.9	384	2.6
February 23, 1904	55	13.3	416	
Experiment No. 6.				
November 10, 1904	44	*26.9	1068	—*5.1
February 23, 1905	43	32.0	1360	
Experiment No. 7.				
November 14, 1905	52	53.8	1560	38.8
February 16, 1906	....	15.0	....	
Average 7 Experiments				11.3

*Fully 25 winter killed.

The average of seven experiments shows a gain of 11.3 bushels or 73 per cent from sowing Red oats in November as compared with sowing them in February. Who can afford such a loss? Who would not arrange to pay his notes three months ahead of maturity if thereby he could have 43 per cent deducted from their face? The two cases are arithmetically the same. If the "turning out" of cattle by common consent in winter prevents the sowing of grain in the fall, is the few months' winter range worth the sacrifice?

Other experience, often repeated, has shown us that the average date of fall sowing in the table above, November 17, is too late for maximum yields of fall sown oats. We have found that sowing in October gives a larger yield and the plants endure cold better than do plants from sowings made in November. I would recommend October sowing, while realizing that any date between September 1 and November 15 may afford satisfactory yields. We find it advisable to discontinue entirely the sowihg of oats about the first of December. For such fields as must be sown after Christmas I prefer on the uplands in this latitude to sow about February 1. For oats sown after Christmas only the richest lands are suitable and these are needed for other crops. On the other hand, oats sown in the fall may make a profitable crop on land that is quite poor, provided they be judiciously fertilized. Thus the advantages of fall sowing consist of (1) a much larger yield, even after deducting the losses from partial winter killing; (2) the utilization of poorer land by the fall sown crop, (3) the employment of teams at a time when they are not needed in preparation of land for cotton or corn, and (4) earlier maturity of fall sown oats, permitting the use of the crop and the use of the land at least two weeks earlier than when oats are sown after Christmas.

METHODS OF SOWING OATS.

A method of sowing oats that has proved highly satisfactory as the most effective known means of avoiding winter killing consists in opening deep furrows at intervals of 18 to 24 inches and drilling the seed and fertilizer in the bottom of these furrows, barely covering the seed with such earth as falls in as the one-horse planter and fertilizer distributor passes along. The primary object is to reduce the amount of killing by placing the plants in a position where they will not be heaved by alternate freezes and thaws.

For four years we have compared this method with a modification of the same, in which the deep furrows were covered nearly or quite full after the sowing of the seed, and with broadcast sowing.

In 1900 a harrow was run over all plots and dragged in more dirt than was intended. That year the "covered" drills were filled and the oats covered by the use of scooters on a double stock. In 1899-1900 the drilled oats were scarcely injured by cold, while the broadcast plots lost about 25 per cent of their plants, and yielded far less grain than either method of drilling. In 1904 the broadcast plots lost about 20 per cent of their plants from winter killing, while the loss from cold in the drilled plots was insignilcant; some plants in the deep, partially filled furrows were injured by sand washing in.

In 1905 there was some loss from cold on all plots, this being estimated at 20 per cent on the broadcast plots, 10 per cent on the plots sown in filled furrows, and only 5 per cent in furrows only partially filled.

In the average results and in three out of four years drilling oats in furrows two feet apart yielded decidedly more than did the sowing of the seed broadcast on the plowed ground and covering with a disc harrow or other similar implement.

No very severe winter occurred while this test was in progress, which probably accounts for the practical equality in resistance to cold of the plants in the filled and in the partly filled furrows.

For well drained soils there are decided advantages in drilling fall sown oats in deep furrows, especially when the winter proves severe. It is advisable where practicable to run the rows perpendicular to the line of the coldest winds, which would give the rows a direction from southwest to northeast, or east and west.

This method of sowing oats in deep unfilled furrows is

evidently not adapted to prairie or other very stiff, poorly drained soil, where standing water in the furrows would drown the young plants, and it is slower than sowing broadcast or using a grain drill.

Yields of oats sown broadcast and in deep furrows, or entirely drilled.

Year	Yield per acre.			
	Broad-cast	8 in. drill	Deep furrow, slight covering	Deep furrow, covered
	Bus.		*Bus.*	*Bus.*
1900	19.9		24.3	29.1
1903	26.4		33.7	25.7
1904	16.0		19.2	20.5
1905	34.6	31.0	32.3	31.5
Average	24 2		27.4	26.7

INCREASING THE HARDINESS OF OATS.

In a severe winter the oat plants that survive the winter are either those best protected by their location or else those possessing in themselves a special degree of hardiness. If we could plant seed only from plants possessing this inherent hardiness we should doubtless be able within a few years to breed up a variety hardy enough to endure the severest winters. The Alabama Experiment Station has for several years been engaged in this attempt to increase the hardiness of our ordinary Red Rust Proof oats towards cold. Since we cannot separate those plants whose survival of winter's cold is merely accidental, or due to their environment, from those planst that have in themselves special hardiness, our task will doubtless take many years for its accomplishment. For though we select each year from plants that survived the previous winter and whose ancestors survived still earlier winters, yet among these continuously hardy plants are many tender plants that have endured the

cold merely because of favorable environment. It will require the recurrence of several severe winters to eliminate all the tender plants.

In thus breeding the oat plant for improvement in hardiness we also had an opportunity to ascertain whether seed oats for sowing in the fall should come from a strain sown each year in the fall or indifferently from either fall or spring-sown ancestry. The following table presents the results of this inquiry to date.

Yields of oats from sowing in the fall seed from fall-sown vs. spring-sown ancestry.

Year	Variety	Date of sowing	Yield per acre			
			Fall strain		Spring strain	
			Straw	Grain	Straw	Grain
			Lbs.	*Bus.*	*Lbs.*	*Bus.*
1898	Red Rust Proof	Nov. 6	1050	25.3	996	28.6
1903	Red Rust Proof	Nov. 13	1110	21.3	505	11.3
1904	Red Rust Proof	Nov.	960	30.0	888	27.7
1905	Red Rust Proof (Broadcast)	Nov. 5	1352	35.5	1160	33.7
1905	Red Rust Proof (8-in. drills)	Nov. 5	1256	31.0	1128	31.0
1006	Red Rust Proof (8-in. drills)	Nov. 18	1936	50.9	2112	51.0
1906	Red Rust Proof (8-in. drills)	Nov. 14	1560	53.8	1590	62.5
1906	Burt	Nov. 14	1676	45.6	1892	46.5
	Average		1223	36.7	1283	36.5

Thus far the difference in yield is slight and accidental between a strain of oats that for several years has been continuously sown in the fall and other oats descended from crops alternately sown in fall and in spring. In the above table the fall strain of Red Rust Proof oats has been continuous, having been sown in the fall of 1902, 1903, 1904, 1905: in 1902 the fall sown seed were from the station farm where nearly all the oats are sown in the fall, and hence the habit of growing in winter extends back at least five years prior to 1902. The "spring strain" seed oats does not represent a continuously spring-sown ancestry, but usually only one generation of spring-sown oats. This experiment with Red

oats will be continued. Until we can accumulate conclusive data we can advise only on theoretical considerations. These suggest the probable advisability of sowing in the fall seed from a strain that for several years has been sown in the fall. This is another argument for saving one's own seed oats, for we seldom know whether purchased seed oats are accustomed to fall or to spring planting nor whether grown in or near this latitude.

PREVENTION OF SMUT.

Smut is almost universally present in the oat fields of Alabama, blackening many of the heads and reducing the yield from 5 to 30 per cent. It can be prevented easily and cheaply. Several methods may be used, the most convenient being the use of formalin. Unfortunately this useful material is not generally found in the smaller drug stores but may be ordered from wholesale drug stores through local druggists. The cost should not exceed one dollar per pound including express charges, and in large amounts the cost is much lower. Pour one ounce of this liquid formalin into three gallons of water. Into this liquid the oats may be dipped and then drained and spread out to dry, or the liquid may be sprinkled over the pile of oats until the grains are thoroughly moistened. Then the pile of treated seed should be kept covered from two to ten hours, so that the gas generated may destroy the germs or "seed" of smut, which are present on the oat kernel. One ounce of formalin will treat a number of bushels of oats, making the cost only a few cents per acre. The saving or increase in the crop will usually be from 8 to 20 per cent, or say 2 to 8 bushels per acre. We cannot afford to plant oats without this or equivalent treatment.

In case formalin is not quickly obtainable smut in oats may be destroyed by the following method: Obtain an accurate thermometer. A dairy thermometer costing 25 to

50 cents will usually answer. Then dip the bags of seed oats into hot water which must be kept at a temperature of about 132 degrees, not dropping below 130 nor running above 135 degrees Fahrenheit. Keep the oats in this hot water for ten or twelve minutes, stirring them so that every grain becomes heated. Then remove the sack of oats and dip into cold water. After this cooling the oats should be spread out to dry, never spreading them on a floor on which untreated seed oats have been stored.

FERTILIZERS FOR OATS.

It is a custom far too common in Alabama to sow oats without any fertilizer. The experiments here recorded show that it pays to fertilize oats, and that the most profitable fertilizer is one that is rich in nitrogen. Omitting the long table of figures, the conclusions drawn from average results of a number of years' experimentation in Auburn are here given. On our sandy and loam soils rather heavily fertilized with complete commercial fertilizers for a number of years, the results were briefly as follows: Potash was practically useless; acid phosphate was of secondary importance, while nitrogen in whatever form applied, whether as stable manure, cotton seed, cotton seed meal, or nitrate of soda, gave a considerable increase in the yield of oats.

BARNYARD MANURE AS A FERTILIZER FOR OATS.

For several years an experiment has been in progress to determine the increase in various crops due to the application of manure during the current or previous season. Only such of these data as bear on the oat crop are here given. In the winter of 1900 heavy applications of cattle manure, obtained by the use of a ration of cotton seed meal or of cotton seed, were applied to fall-sown oats. The following table shows the results obtained the first year, in which the

increase in yield was 29.6 or 31.5 bushels of oats per acre:

Immediate or first year effect of cattle manure applied to oats.

Manure per acre.	Manure from feeding.	Yield per acre.	Increase per acre.
Lbs.		*Bus.*	*Bus.*
43740	C. S. Meal, etc.,	40.7	31.5
30600	Cotton Seed, etc.	38.8	29.6
No manure		9.2	

The next year oats were again grown on the same field without additional fertilizer.

Manure per acre previous year	Yield per acre second year.	Increase per acre second year.
Lbs.	*Bus.*	*Bus*
43740	37.5	26.
30600	28.	16.5

Even on this sandy soil a heavy application of stable manure gave a large increase in the second crop of oats, as well as in the crop to which it was directly applied. The important matter is to determine what increase in crop was afforded by each ton of manure, and this information is contained in the following table, which deals not only with this experiment, but with two others in which very light applications of horse manure were employed.

Increase in first and second crops of oats per ton of manure.

Manure per acre	Kind of Manure	Increase per ton of manure		
		First year oats	Second year Oats	Total 2 years Oats
Tons		*Bus.*	*Bus.*	*Bus.*
21.87	Cattle; from feeding c. s. meal, etc.	1.4	1.2	2.6
15.3	Cattle; from feeding cotton seed,etc.	1.9	1.1	3.0
6.2	Cattle; from feeding c. s. meal, etc.	1.6	.5	2.1
2.°	Horse manure................	8.8		
2.°	Horse manure	9.8		

From the above table it will be seen that where heavy applications of rich cattle manure were made to oats the aggregate increase in yield of the two following crops was 2.8 bushels per acre and that of this the second year's increase accounts for more than one bushel. On the other hand, when only two tons per acre of horse manure was used the increase the first year averaged 9.3 bushels per acre. This illustrates the greater efficiency per ton of the smaller applications, though the broadcast application of less than four tons per acre is scarcely practicable even by the use of the manure spreader. This expensive piece of farm machinery is needed where large amounts of manure are to be distributed, for it greatly reduces the amount of labor in handling manure, pulverizes the material finely, and enables a lighter application to be made where this is desired, the lighter application and the finer pulverizing making a given amount of manure go further and afford a larger increase in crop yield.

COTTON SEED VERSUS COTTON SEED MEAL.

In three experiments made in as many different years we have compared 200 pounds of cotton seed meal with 434 pounds of cotton seed, both furnishing equal amounts of nitrogen and both being applied at the time of planting in the fall. In every case cotton seed meal has given larger yields, the excess resulting from the use of meal as compared with seed being in different years respectively 2.1, .7 and 11.8 bushels of oats per acre, which would give an average advantage of 4.9 bushels per acre to the meal. If we reject the last figure as being so large as to excite suspicion of error we still have an average advantage of 1.4 bushels per acre in favor of the cotton seed meal.

While cotton seed has long been recognized as an excellent fertilizer for oats, especially when used in large amounts, the increased price of cotton seed and the superior effects of an equal value of nitrate of soda on oats

make it unadvisable to apply cotton seed to the oat crop if nitrate of soda can be purchased.

Since the fertilizer requirements of wheat and oats are presumably about the same, I would add that in similar experiments with wheat cotton seed meal gave a slightly larger yield than cotton seed, both used in the amounts mentioned above.

NITRATE OF SODA AS A FERTILIZER FOR OATS.

Numerous experiments made under the writer's direction both on sandy loam soil at Auburn and on stiff lime lands at Uniontown show that this is by far the most effective commercial fertilizer for oats. The following table affords means of comparing nitrate of soda with cotton seed meal, cotton seed, and stable manure, which are the principal sources of fertilizer nitrogen available to the southen farmer.

Cotton seed meal, cotton seed, nitrate of soda, and manure as fertilizers for oats.

Amount per acre.	FERTILIZER	Yield and increase per acre							Average increase per acre due to Nitrogen.
		1901			1906				
		Yield straw	Yield grain	Increase in grain due to Nitrate.	Yield straw	Yield grain	Increase due to Nitrate		
Lbs.		*Lbs.*	*Bus.*	*Bus.*	*Lbs.*	*Bus.*	*Bus.*		*Bus.*
200 240	Cotton seed meal Acid Phosphate	827	24.9	8.0	1788	42.9	13.0		10.5
434 240	Cotton Seed Acid Phosphate	774	24.2	7.3	1136	32.1	2.2		4.8
240	Acid Phosphate	532	16.9	0.0	1160	29.9	0.		
100 240	Nitrate of Soda (in spring) Acid Phosphate	1130	36 3	19.4	1776	55.8	25.9		22.7
100 240	Nitrate of Soda (at planting) Acid Phosphate	1222	36.0	19.1	2128	54.4	24.5		21.8
4000	Manure	1152	34 4	17.5	2152	51.5	21.6		19.6

Referring to the figures in the preceding table, we have the following comparison between the results of 2 tons of

fine horse manure and an application of 100 pounds of nitrate of soda together with 240 pounds of acid phosphate, the phosphate being applied at time of sowing in the fall and the nitrate being applied as a top dressing in March.

With two tons of fine horse manure applied in the fall the average increase was 19.6 bushels of oats per acre; with the commercial fertilizer mixture the average increase was 22.7 bushels of oats. In other words equal first-year results were obtained from the use of one ton of manure as from 43.1 pounds of nitrate of soda aided by 103 pounds of acid phosphate. With nitrate at $60 and phosphate at $12.50 per ton these amounts of commercial fertilizer cost $1.93. Hence the farmer could afford to invest at least this amount in the production or purchase and very thin distribution of one ton of fresh unleached horse manure, and still be ahead by the greater effect of manure than of chemicals after the first year. We have seen in a preceding paragraph that the second year effect of a ton of manure on our sandy loam soils is equivalent to more than one bushel of oats per acre.

While the application of stable manure to oats on poor land is to be commended, yet the limited supply of this material makes it necessary for the farmer to purchase nitrogen in commercial fertilizers. Probably even better use for manure can be made than to apply it on oats, thus making it necessary to purchase nitrate of soda for oats and other small grain.

The following table shows the results of 13 different experiments conducted under the writer's direction at Auburn and Uniontown, Ala., and bearing on the effects of nitrate of soda applied in March as a top dressing for oats:

Year	Date of sowing oats	Amt. of nitrate per acre	Date of applying nitrate	Yield per acre	Increase due to nitrate	
Fall sown		*Lbs.*		*Bus.*	*Bus.*	*Percent*
1904	Nov. 4,	200	March	49.5	32.3	188
*1903	Oct.	200	March	43.8	25.3	137
Av.		**200**		**46.7**	**28.8**	**163**
1906	Nov. 20	120	March 13	34.2	21.8	176
1901	Nov. 15	100	March 18	36.3	19.4	116
1906	Nov. 15	100	March 13	55.8	22.7	69
*1903	Oct.	100	March	34.0	14.8	77
*1904	Nov. 4	100	March	42.3	17.0	67
Av.		**100**		**42.1**	**18.5**	**82**
1896	Oct.	80	March 28	29.3	12.9	79
1906	Nov. 20	60	March 13	28.0	15.6	126
1904	Nov. 4	50	March	29.0	11 3	64
Av.		**63**		**28.78**	**13.3**	**90**
Spring sown						
1896	Jan. 27	120	March 28	20.3	9.9	95
*1903	March 19	80		29.0	8.0	38
1900	Feb. 20	76	March 25	19.7	7.4	60
Av.		**92**		**23.**	**8.4**	64

*On stiff lime land at Uniontown; from Bul. 22, Ala., Cane-brake Exp. Station, by J. F. Duggar and J. M. Richeson.

In the following table the preceding data are so arranged as to show average results from the use of different amounts of nitrate of soda on oats:

Increase and profit from nitrate of soda and cost of fertilizer per bushel of increase.

Nitrate of soda per acre	Inc'ase due to nitrate per acre	Profit per acre from nitrate	Inc'ase due to nitrate	Lbs nitrate per bushel of increase	Cost per bu. of increase	Year	Soil
Lbs.	*Bus.*	*$*	*Per ct*	*Lbs.*	*$*		
Fall sown							
200	32.3	10.15	188	6.2	0.186	1904	Lime
200	25.3	6 65	137	7.9	0.237	1903	Lime
Av. 200	**28.8**	**8.40**	**163**	**7.0**	**0.211**		
120	21.8	7.60	176	5.5	0.165	1906	Sandy loam
100	19.4	6 70	115	5.2	0.156	1901	Sandy loam
100	22 7	8.35	69	4.4	0.132	1906	Sandy loam
100	14.8	8.40	77	6.9	0.207	1903	Lime
100	17.0	4.50	67	7.1	0.213	1904	Lime
Av. 100	**18 5**	**6.19**	**82**	**5 9**	**0.177**		
80	12.9	4.05	79	6.2	0.186	1896	Sandy loam
60	15.6	6.00	126	3.9	0.117	1906	Sandy loam
50	11.3	4.15	64	4.4	0.132	1904	Lime
Av:50to80	**13.3**	**4.73**	**90**	**4.8**	**0.145**		
Spring S.							
120	9.9	1.35	95	12.1	0.363	1896	Sandy loam
80	8.0	1.60	38	10.0	0.300	1903	Sandy loam
76	7.4	1.42	60	10.3	0.309	1900	Sandy loam
Av. Sp. S.	**8.4**	**1.45**	**64**	**10.8**	**0.324**		

In the above table the figures representing the averages are highly significant and worthy of careful study. They show that from 200 pounds of nitrate of soda the average increase was 28.8 bushels of oats per acre; from an appliing 63 pounds of nitrate of soda), the increase was 13.3 bushels; and from the application of smaller amounts (averaging 63 pounds of nitrate of soda, the increase was 13.3 bushels of oats per acre. It is notable that when nitrate was applied to spring sown oats the results were less favorable than when used on fall sown oats, the application of an average of 92 pounds of nitrate on spring-sown oats giving an

increase of only 8.4 bushels. The percentages of increased yield were respectively 163, 82, 90, and 64.

The fifth column of the table shows the number of pounds of nitrate of soda required per bushel of increase of yield, namely 7.1 pounds where 200 pounds per acre was employed, 5.9 pounds where the application was 100 pounds of nitrate of soda. and 4.8 pounds when an average of only 63 pounds of nitrate of soda per acre was used on fall sown oats. These figures again show the greater relative efficiency of the smaller applications. Notice again that it takes more fertilizer to add a bushel to the crop in the case of spring sown oats, namely, 10.8 pounds of nitrate of soda per bushel of increase, or nearly twice the fertilizer necessary to the same results on fall sown oats. The average cost of nitrate of soda to make one bushel of increase was 21.1 cents for the very heavy application; 17.7 cents when 100 pounds of nitrate of soda was applied, and only 14.5 cents when a very light application was made to fall-sown oats. When, however, a light application of nitrate was made to spring-sown oats each bushel of increase cost for nitrate of soda, 32.4 cents, a further proof of the greater profit from fall sown oats. If we will think of oats as worth 50 cents per bushel we will notice that after deducting the cost of the fertilizer, each bushel of increase made by fall-sown oats and due to nitrate of soda afforded a profit of from 28.9 cents to 35.5 cents, the greater profit per bushel being obtained from the smaller applications.

After all, profit is the important consideration, therefore, let us examine the financial returns per acre from the use of nitrate of soda. After deducting the cost of nitrate of soda at the rate of $60.00 per ton we have left a profit of $8.40 from an application of 200 pounds per acre; a profit of $6.19 from an application of 100 pounds; and a profit of $4.73 from a light application, averaging 63 pounds of

nitrate of soda per acre. Surely farmers cannot afford to withhold this fertilizer when profits like these can be had by its judicious use.

These facts appear in still more striking form when we figure the percentage of profit on the amount invested in nitrate of soda. When this fertilizer was used at the rate of 200 pounds per acre the profit on the fertilizer investment was 140 per cent; 206 percent when the fertilizer was used at the rate of 100 pounds per acre; and 249 percent when a lighter aplication was made on fall-sown oats. These last figures illustrate the general tendency of fertilizers to return the largest percent on the investment in fertilizers when used in small amounts. But this alone should not govern, for preceding figures have shown that heavier applications afford a greater aggregate profit per acre, and hence are advisable for the farmer who has abundant capital to invest in fertilizers.

I recommend that nitrate of soda be used at the rate of from 60 to 100 pounds per acre, according to the amount that the farmer can afford to invest in fertilizers. From such an investment he should expect to realize a profit of $4.00 to $6.00, provided the application be made to fall sown oats. If the nitrate be used on spring sown oats the profit may be only about half of the above figures, but even here fertilization with nitrate of soda is advisable.

WHEN TO APPLY NITRATE OF SODA.

The experiments conducted in Auburn, and recorded in Bulletin No. 95 of this Station, indicate that nitrate of soda should be applied early enough to give at least 55 days before the time of application and the probable date of harvesting the grain. Any time in March is suitable. We have found nitrate of soda applied as a top dressing in March more effective with oats and wheat than when put into the ground with the seed in the fall. This superiority of the spring application has been greater with wheat than

with oats and much greater on quite sandy soil than on gravelly soil containing considerable clay, on which stiffer soil both fall and spring applications have greatly increased the yield of oats.

All lumps in the nitrate of soda must be carefully pulverized. The fertilizer is strewn by hand, and distributed as evenly as seed oats or seed wheat would be. No covering or harrowing is necessary. This fertilizer is so readily soluble that a small amount of moisture in the soil will dissolve it and carry it downward to the plant roots. It is best to sow nitrate of soda when the ground is somewhat moist, but one should avoid applying it just before a rain, which might wash away a large part of the nitrogen. Hence if practicable we prefer to apply nitrate of soda just as the weather clears after a period of rainy weather. We usually apply this fertilizer to oats about the middle of March, though application at any date within that month is satisfactory.

LEGUMINOUS PLANTS AS FERTILIZERS FOR OATS.

Cowpea or velvet bean stubble or entire growth as fertilizers. We have seen that of the commercial fertilizers the one best adapted to oats is nitrate of soda, but since the use of this material involves a cash expenditure, we may well inquire whether some fertilizing material produced on the farm may not act as a substitute. The principal materials that might thus be used are barnyard manure, which has already been discussed, and leguminous plants, such as cowpeas, soy beans, velvet beans, etc. Both the entire plant and the roots and stubble alone of these legumes are rich in nitrogen and hence useful as nitrogenous fertilizers. The following table, quoted from Bulletin No. 95 of this Station, gives the result of an experiment in which the use of either the stubble or entire plant of cow peas or velvet beans afforded an enormous increase in the yield of the

succeeding crop of oats, an increase larger than we can usually count on. The Red Rust Proof oats were sown in the fall of 1897 and the crop was cut May 18 following.

On all plots oats were fertilized with 220 pounds per acre of acid phosphate and 44 pounds of muriate of potash, no nitrogen being supplied except that contained in the remains of preceding crops of cowpeas, velvet beans, etc.

Yield per acre of oats grown after stubble or vines of cowpeas, velvet beans, etc.

Plot No.		Yield per acre	
		Grain	Straw
		Bus.	*Lbs.*
1	Oats after velvet bean vines	28.6	1206
6	Oats after velvet bean stubble	38.7	1672
	Average after velvet bean vines and stubble	**33.6**	**1439**
4	Oats after cowpea vines	28.8	1463
3	Oats after cowpea stubble	34.4	2013
	Average after cowpea vines and stubble	**31.6**	**1738**
2	Oats after crab grass and weeds	7.1	231
5	Oats after German millet	9.7	361
	Average, after non-leguminous plants	**8.4**	**296**

From early spring there was a marked difference in the appearance of the several plots, the plants being much greener and taller where either the stubble or vines of cowpeas had been plowed under.

When the oats began to tiller, or branch, the difference increased, the plants supplied with nitrogen, through the decay of the stubble or vines of cowpeas and velvet beans, tillering freely and growing much taller than the plants following German millet or crab grass.

May 18, 1898, oats on all plots were cut.

In this experiment the average yield of oats was 33.6 bushels after velvet beans, 31.6 bushels after cowpeas, and only 8.4 bushels after non-leguminous plants (crab-grass, weeds and German millet).

Here is a gain of 24.2 bushels of oats and nearly three-fourths of a ton of straw as a result of growing leguminous

or soil improving plants, instead of non-leguminous plants during the preceding season.

Undoubtedly this is an extreme, and not an average, case. An unexpected result of this experiment is the larger crop on the plots where only the stubble was left than on those where the vines of cowpeas and velvet beans were plowed under. The writer thinks that the difference in yield was almost wholly due (1) to the fact that the vines (especially those of the velvet beans) were not properly buried by the small plow employed, and (2) that the seed bed for oats was more compact where only stubble was plowed under, a point of advantage, doubtless, in such a dry winter as that of 1897-'8. In Bulletin No. 120, of this station, we have shown that the residual fertilizing effect of the entire growth of legumes is greater than that of vines and stubble. For example, the average increase in the second crop after plowing under *stubble* of velvet beans and cowpeas averaged 12 per cent. while the increase of the second crop was 24 to 54 per cent where the *entire growth* of legumes was plowed under.

When spring sown oats follow leguminous plants the increase due to the legume is smaller than is indicated above. For example, in one of our experiments the yield of spring sown oats following German millet was 12.4 bushels per acre, while on an adjacent plot where cow pea vines had been plowed under the yield was 22.8 bushels. This gives an increase of 10.4 bushels per acre, worth $5.20, as the fertilizing effect of a crop of cow pea vines of which the pods had been previously picked, yielding 11 bushels of cowpeas per acre. Thus the total value of the cow pea crop was about $16 in addition to any fertilizing effect that may have extended to the second crop.

Cowpeas, peanuts and soy beans as fertilizers for oats.

The following table shows the yield of oats in 1906 on one of the poorest tracts of land on the station farm, which

would be classed as a poor grade of Norfolk sandy loam. It is a deep sandy soil, light gray in color. The table shows the yields of unfertilized oats when grown after each of the following crops: Sorghum, sweet potatoes, soy beans, chufas, corn, Whippoorwill cow peas, Spanish peanuts, and running peanuts.

Effects of preceding crop on yield of fall sown oats in 1906.

Preceding crop	Part plowed under	Oats per acre	
		Yield	Increase compared with oats after corn
		Bus.	*Bus.*
Sorghum, drilled	Stubble	12.4	—1.3
Sweet potatoes	Vines	12.4	—1.3
Chufas	Tops only	11.7	—2.0
Corn	Stubble	13.7	
Whippoorwill cowpeas (drilled, picked)	Vines after picking	19.9	6.2
Spanish peanuts	Shed leaves, etc	26.7	13.0
Running peanuts	All except nuts	30.0	16.3
Soy beans, drilled	Stubble	21.4	7.7
Soy beans, drilled	Entire growth	42.2	28.5
Sorghum; 60 lbs. nitrate of soda	Stubble on oats.	28.0	14.3
Sorghum; 120 lbs. nitrate of soda	Stubble on oats.	34.2	20.5

From this table we learn that a preceding crop of drilled Whippoorwill cow peas plowed under after the pods were picked and removed (yielding 17.5 bushels of cowpeas per acre), increased the crop of oats 6.2 bushels per acre as compared with the preceding crop of corn. This makes the crop of drilled cowpeas worth for seed and fertilizer at least $20.00 per acre. Where peanuts were grown the increase was 13 to 16.3 bushels per acre; when soy beans, sown in drills, were cut and used for hay the remaining stubble increased the following oat crop 7.7 bushels per acre. When the entire crop of soy beans was plowed under the increase was 28.5 bushels.

It is interesting to notice that so far as measured by the first crop of oats 60 pounds of nitrate of soda was worth more than the stubble of soy beans or the picked vines of cow peas and worth nearly as much as the picked vines of running peanuts; 120 pounds of nitrate of soda gave a larger immediate result than any of the leguminous plants except soy beans where the entire growth was plowed under.

From all the experiments detailed above and from others it seems safe for a farmer by growing a crop of cowpeas before oats, to expect to increase the yield of oats by from 5 to 15 bushels or more per acre, whether the peas are simply picked or cut for hay.

In another experiment oats constituted the second crop after the plowing under of the picked vines of drilled cowpeas on a good grade of reddish loam soil, with retentive sub-soil. The increased yield on plots where cowpeas had grown two years before was 9.75 bushels of oats per acre, as compared with adjacent plots on which cotton had grown continuously for several years.

OATS AS A HAY CROP.

Good hay is made from oats cut when in the early dough stage.

On deep, gray, sandy soil (Norfolk sandy loam) two plots of Hatchett's Black oats were sown October 24. Both were fertilized at the time of sowing with 360 pounds of acid phosphate and 48 pounds of muriate of potash. The plots receiving no nitrogen yielded 678 pounds of cured hay per acre. The plots fertilized March 20 with 80 pounds of nitrate of soda per acre yielded 2,120 pounds of hay, or about 3 1-2 times as much as the plots without the nitrogen. From this late variety of oats the hay was ready to cut May 15. With Red oats the date for cutting oat hay is usually earlier.

PLACE OF OATS IN THE ROTATION ON THE COTTON FARM.

The small acreage devoted to oats on most cotton farms makes this crop a negligible factor in the farm rotation. Un-

doubtedly as the supply of labor decreases and the presence of the boll weevil makes it necessary to reduce the acreage and to intensify the fertilization and cultivation of cotton, oats will be grown on a more extensive scale. Even under present conditions it will be profitable to greatly extend the acreage in oats. Among the arguments for this increase is the fact that farmers seldom reserve any large acreage for cow peas except the land occupied during the earlier part of the year by a crop of small grain. More oats means more cow peas and more cow peas means a larger crop of cotton on this land the following and succeeding years. A desirable rotation for a cotton farm on which it is considered necessary to devote half of the land to cotton is the following:

1st year: Corn, with cow peas between the rows.

2nd year: Oats, followed by cowpeas, which may be cut for hay, picked, or grazed, or simply plowed under in December, January, or February, as fertilizer for the succeeding crop of cotton.

3rd year: Cotton.

4th year: Cotton.

A still more rapid improvement of the land would result from sowing crimson clover, properly inoculated, or other suitable winter growing leguminous plant in September among the growing cotton plants, covering with a one-horse harrow used just after the first or second picking, when little or no injury would be done to the cotton.

On a farm where stock is kept and where cotton requires only one-third of the cultivated area the rotation would be that given above for the first, second and third years, that is, corn, with cow peas; then oats, followed by cow peas; then cotton, and the fourth year corn again.

HOME GROWN SEED OATS.

While this Station has made no experiments comparing southern seed oats with those grown further north or west,

our experience shows that oats grown continuously for a number of years in Alabama do not "run out."

We use our own seed of Red Rust Proof oats year after year and our average yield in recent years has been greater than it was ten years ago. On farms where fair crops of oats are grown it is far better to save one's own seed than to buy seed of unknown origin, which may contain Johnson grass or other seed,and which may be otherwise objectionable.

Acknowledgements are hereby made to the following parties who at various times have participated in the conduct of the experiments herein recorded.

T. U. Culver, formerly Superintendent of the Farm; C. M. Floyd, Superintendent of the Farm during the past three years; and L. N. Duncan, Assistant in Agriculture, who has aided in the preparation of the tables in this bulletin.

FIG 1.—*Burt oats, April 23, 1906; right sown in November; left sown in February.*

Fig. 3 .—*Burt oats, May* 10, 1906*; left sown in November; right sown in February.*

Fig. 4.—*Red oats, May* 10, 1906*; left sown in November; right sown in February.*

FIG. 5.—*Red oats, May 29; right sown in November; left in February.*

FIG. 6.—*Red oats, April 23; fall sown; spring strain on left; fall strain on right.*

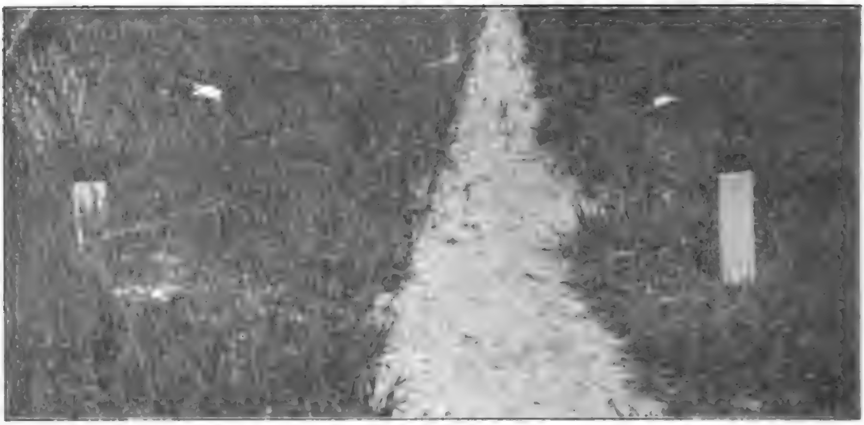

Fig. 7.—*Culberson on left, Turf on right, April 24; stakes 2 ft. high.*

Fig 8.—*Red oats on left, Turf oats on right, May 29,* 1906.

BULLETIN NO. 138 DECEMBER, 1906

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

VARIETY TESTS WITH COTTON AND CORN.
Williamson Method of Corn Culture.

BY

J. F. DUGGAR, Director

AND

L. N. DUNCAN, Assistant in Agriculture.

Opelika, Ala.:
The Post Publishing Company,
1906.

The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

VARIETY TESTS OF COTTON

BY J. F. DUGGAR, DIRECTOR AND AGRICULTURIST

AND

L. N. DUNCAN, ASSISTANT IN AGRICULTURE.

In order that the results of our unpublished variety tests of cotton may be in the hands of farmers in ample time for use in making plans for another year, this brief bulletin is presented. The results of other experiments made in 1905 and 1906 with cotton and corn will be reserved for future publications.

In addition to the varieties of cotton grown in plots of sufficient size to give an accurate measure of the yield per acre, a much larger collection of varieties has been grown, each on a small area, with a view to making descriptions of all obtainable varieties. We expect to publish a bulletin containing all these descriptions early next spring.

The two tables that follow give the yields in plot tests with 32 varieties of cotton in 1905 and with 20 varieties in 1906.

They were grown on ordinary upland. The soil where this test was made in 1905 was a stoney, reddish-gray sandy loam and the soil where varieties of cotton grew in 1906 was a gray sandy loam free from stones.

Yields of lint and seed and total value per acre of varieties of cotton in 1905.

Rank	Variety	Yield lint per acre	Yield seed per acre	Total value per acre*
		Lbs.	*Lbs.*	
1.	Toole	531.2	851.2	$67.04
2.	Cook's Improved	528.0	828.8	66.52
3.	Cleveland	520.0	840.0	65.68
4.	Bancroft's Herlong	488.0	948.8	61.76
5.	Christopher	480.0	916.8	61.62
6.	Schley	480.0	880.0	61.36
7.	Rowden	480.0	868.8	61.28
8.	Pullnot	480.0	768.0	60.58
9.	Layton	480.0	756.[illegible]	60.49
10.	Russell	464.0	896.0	59.62
11.	Strickland	459.2	902.4	59.12
12.	Willett's Red Leaf	452.8	792.0	57.61
13.	Crossland	456.0	723.2	57.50
14.	Hawkins	456.0	688.0	57.26
15.	Alex. Allen	440.0	832.0	56.42
16.	Culpepper (av. 5 plots)	433.6	812.5	55.55
17.	Haggaman	432.0	776.0	55.11
18.	Peterkin	432.0	688.0	54.50
19.	Texas Bur	424.0	806.4	54.40
20.	Southern Wonder	420.8	819.2	54.11
21.	Blue Ribbon	416.0	916.8	54.06
22.	Cameron	424.0	736.0	53.91
23.	Truitt	416.0	768.0	53.22
24.	Woodfin's Prolific	404.8	800.0	52.15
25.	Jackson's Limbless	411.2	691.2	52.13
26.	King No. 1	408.0	696.0	51.79
27.	Shine	400.0	792.0	51.54
28.	No. 148 (U. S. D. A. Selec.)	400.0	772.8	51.41
29.	Berry's Big Boll	392.0	824.0	50.85
30.	Welborn's Pet	376.0	680.0	48.00
31.	Rogers	324.0	611.2	41.54
32.	Dickson†	160.0	320.0	20.64

*Lint at 11 1-2c; seed at 70c.
†Ruined by boll rot.

The fertilizer used consisted of the following ingredients and amounts per acre, all applied before planting:

1905.		1906.
80 lbs.	Nitrate of soda	80 lbs.
160 lbs.	Cotton seed meal	80 lbs.
240 lbs.	Acid phosphate (14 per ct. available)	200 lbs
64 lbs.	Muriate of potash	48 lbs.
544 lbs.		408 lbs.

The crop was injured by excessive shedding late in the summer of 1906, and by a severe wind and rain storm in September, 1906, which considerably reduced the yield.

Yields of lint and seed and total value per acre of varieties of cotton in 1906.

Rank	VARIETY	Yield lint per acre	Yield seed per acre	Total value per acre*
		Lbs.	*Lbs.*	
1.	Cook's Improved	617.6	1076.8	$69.30
2.	Cleveland	608.0	1184.0	69.09
3.	Layton	612.8	1072.0	68.78
4.	Toole	608.0	1048.0	68.14
5.	Pullnot	596.8	1124.8	67.55
6.	King No. 1	592.0	1136.0	67.15
7.	Peterkin	588.8	1076.8	66.42
8.	Hawkins	552.0	1088.0	62.82
9.	Alex. Allen	536.0	1072.0	61.10
10.	Pride of Georgia	516.8	1200.0	60.08
11.	Willett's Red Leaf	512.0	976.0	58.03
12.	Christopher	504.0	1008.0	57.46
13.	Culpepper	503.3	1069.0	57.02
14.	Russell (U. S. D. A. Selec.) .	488.0	1048.0	56.14
15.	Sunflower	472.0	1184.0	55.49
16.	Truitt	480.0	1008.0	55.06
17.	Russell (Ala.)	472.0	1016.0	54.31
18.	Floradora	460.8	1108.8	53.84
19.	Bancroft's Herlong	440.0	908.8	50.36
20.	No. 148 (U. S .D. A. selec.) .	390.4	852.8	45.01

*Lint at 10c per pound and seed at 70c per 100 pounds.

The tables show that in total value of lint and seed the five leading varieties were in order in 1905, Toole, Cook's Improved, Cleveland, Bancroft's Herlong, and Christopher, and in 1906, Cook's Improved, Cleveland, Layton, Toole and Pullnot.

Sunflower and Floradora are long staple varieties and such staples commanded in Opelika in the fall of 1906 a premium of about four cents per pound.

By assigning a price of 14 cents per pound to these long staples, the total value of their lint and seed becomes respectively $74.37 and $72.27. However, the land on which

these two varieties and Willett's Red Leaf grew is slightly lower and richer than that occupied by other varieties, so that even at a premium of four cents per pound it is not certain that the long staples head the list in total value of product. The bolls of these two long staple varieties being small picking is more difficult than with big boll varieties like Cook's Improved and Cleveland.

The Experiment Station has no seed for sale or distribution. Hence we give below the addresses of the parties from whom our seed was obtained:

Variety.	Seed from.
Alex. Allen	A. W. Allen, Temple, Ga.
Bancroft's Herlong ..	Edward Bancroft, Athens, Ga.
Berry's Big Boll	Harvey Seed Co., Montgomery, Ala.
Blue Ribbon	South Carolina Experiment Station, Clemson College, S. C.
Cameron	R. R. Cameron, West Green, Ala.
Christopher	R. H. Christopher, LaGrange, Ga.
Cleveland	J. R. Cleveland, Decatur, Miss.
Cook's Improved	J. R. Cook, Schley, Ga.
Crossland	U. S. Dept. of Agriculture, Washington, D. C.
Culpepper	J. E. Culpepper, Luthersville, Ga.
Dickson	Capers Dickson, Oxford, Ala.
Floradora	R. D. Tatum, Palmetto, Ga.
Haggaman	U. S. Dept. of Agriculture, Washington, D. C.
Hawkins	B. W. Hawkins, Nona, Ga.
Jackson's Limbless ...	Harvey Seed Co., Montgomery, Ala.
King No. 1	T. J. King Co., Richmond, Va.
Layton	R. D. Layton, Cresston, S. C.
No. 148 (U. S. D. A.)	U. S. Dept. of Agriculture, Washington, D. C.
Peterkin	J. A. Peterkin, Ft. Motte, S. C.
Pride of Georgia	U. S. Dept. of Agriculture, Washington.
Pullnot	J. E. Bradbury, Athens, Ga.
Rodgers	R. H. Rodgers, Darlington, S. C.
Rowden	J. A. Shine, Faison, N. C.
Russell	James Moore, Auburn, Ala.
Russell (U. S. D. A.) .	U. S. Dept. of Agriculture, Washington.
Schley	R. D. Tatum, Palmetto, Ga.
Shine	J. A. Shine, Faison, N. C.
Southern Wonder	L. F. Grier, Oxford, Ala.
Strickland	U. S. Dept. of Agriculture, Washington, D. C.
Sunflower	M. Schaefer, Yazoo City, Miss.
Texas Bur	C. E. Smith, Locust Grove, Ga.
Toole	W. W. Toole, Augusta, Ga.
Truitt	G. W. Truitt, LaGrange, Ga.
Welborn's Pet	N. L. Willett Drug Co., Augusta, Ga.
Willett's Red Leaf ...	N. L. Willett Drug Co., Augusta, Ga.
Woodfin's Prolific	S. V. Woodfin, Marion, Ala.

TEST OF VARIETIES OF CORN.

All tests of varieties of corn except that made in 1906

were published in Alabama Experiment Station Bulletin No. 134, issued in December, 1905. The results of the experiment made in 1906 are given below.

Yield of shelled corn per acre in 1906.

Rank	Variety.	Per cent stand.	Yield per acre.
		Per ct.	*Bus.*
1.	Sanders	97	28.9
2.	Marlboro	97	28.3
3.	Mosby	93	26.0
4.	Henry Grady	97	25.7
5.	Local White Cob	97	25.4
6.	Albemarle	96	25.1
7.	Experiment Station Yellow	97	24.7
8.	McMackin's Gourd Seed	96	24.4
9.	Cocke's Prolific	97	24.3
10.	Boone County Special	97	24.0
11.	Boone County White (Tenn.)	97	23.7
11.	Boone County White (Ind.)	97	23.7
12.	No. 77 U. S. D. A. Selection	97	23.4
13.	Henry Grady (white cob select)	97	23.1
14.	Red Corn	97	22.3
15.	Hickory King	97	22.0
16.	Leaming	97	18.6
16.	Reid's Yellow Dent	97	18.6
17.	Silver Mine (Iowa)	97	17.9
18.	Riley's Favorite	97	15.7

The best yields were made by Sanders, Marlboro, Mosby and Henry Grady, all except the latter being prolific or several-eared varieties. Sanders, Mosby, and Henry Grady are the varieties which in previous experiments made here have taken high rank. The early northern varieties are again shown to be worthless for Alabama conditions, the yield being low and the grain of very inferior quality.

The fertilizer used per acre consisted of

80 lbs. Nitrate of soda.
80 lbs. Cotton seed meal.
240 lbs. Acid phosphate.
40 lbs. Muriate of potash.

440 lbs. Total

The soil was a reddish-gray, stony, sandy loam, and this

upland field was the same on which the test of varieties of cotton was made in 1905.

We obtained seed of Albermarle from J. E. Stone, Sylacauga, Ala.; Henry Grady from W. J. Headden, Austelle, Ga.; Experiment Station Yellow from Ala. Expt. Sta., Auburn, Ala.

Seed of other varieties except the local white cob and Experiment Station Yellow were furnished by the U. S. Dept. of Agriculture, Washington, D. C., the early varieties having been grown in the North.

WILLIAMSON METHOD OF CORN CULTURE.

The press of the southern states has given much space during the past year or two to a discussion of a method of corn culture successfully practiced and ably advocated by Mr. McIver Williamson, of Darlington, S. C.

The distinctive features of this method are as follows:

(1) Dwarfing the corn plant by withholding fertilizers until the plant is several feet high and by omitting all cultivation from the time the plant is about eight inches high until it is about eighteen inches high.

(2) Thick planting in the row, which is made possible by the small size of the plants.

(3) Use of the turn plow in the last cultivations.

(4) Planting on land enriched by plowing under the entire growth of cowpeas.

To determine whether the dwarfing of plants and thicker planting have a favorable effect on the yield of corn two plots of poor gray sandy upland soil on the Experiment Station farm at Auburn were prepared alike and in accordance with Mr. Williamson's plan, the details being as follows: A fair growth of velvet bean vines was plowed under on both plots with a two-horse plow in February. Then rows were laid off 6 feet apart and bedded out, the water furrow thus formed being subsoiled, by using a Dixie turn plow with wing removed. Then with the same plow a slight list was formed in the water furrow. This list was

opened and corn planted and covered on both plots without fertilizer, planting it thick on the Williamson plot and about half as thick on the check plot. Unfortunately we were not able to plant this experiment early, as is recommended. The first and last cultivations of the two plots were similar. Fertilization of both plots was identical, namely the very heavy application, as advised for the Williamson method, of 200 pounds of cotton seed meal, 200 pounds of acid phosphate and 400 pounds kainit per acre applied to both plots June 23; and 200 pounds nitrate of soda applied to both plots in side furrows July 7.

The details of cultivation were as follows:

Williamson plot.	Check plot.
April 19 planted.	Planted.
May. Middles cultivated shallow.	Middles cultivated shallow.
May 21	Two trips to row with Diverse Cultivator.
June 1	Hoed and thinned to 1 plant every 33 inches.
June 7	Cultivated with scooter and scrape 5 furrows per row.
June 21. Hoed and thinned to 1 plant every 16 inches.	....
June 23. Two side furrows with scooter and scrape.	Two side furrows with scooter and scrape.
June 23. Applied 800 pounds complete fertilizer per acre in side furrows.	Applied 800 pounds complete fertilizer per acre in side furrows.
June 23. Finished cultivating middles deep with Dixie turn plow.	Finished cultivating middles with scooter and scrape.
July 7. Cultivated with scooter and scrape, plowing in cowpeas.	Cultivated with scooter and scrape, plowing in cowpeas.
July 7. Applied in both side furrows 200 pounds nitrate of soda per acre.	Applied in both side furrows 200 pounds nitrate of soda per acre.

A study of the statements above will show that the treatment of the two plots was identical except in the following points:

(1) Later hoeing of the Williamson plot.

(2) Double thickness of planting on the Williamson plot.

(3) Omission of two cultivations on the Williamson

plot, namely, those given to the check plot on May 21 and June 7.

(4) Use of turn plow on the Williamson plot in cultivating middles on June 23.

The result of the thicker planting and the omission of cultivation between the early part of May and June 23 resulted in dwarfing the plants on the Williamson plot, which is the end aimed at in that system of culture. Its advocates claim that the dwarfing of the plant tends to promote the production of grain.

The yield of shelled corn was 30.5 bushels per acre on the Williamson plot and 29.5 bushels per acre on the check plot. This is a gain of one bushel per acre, or 3.4 per cent in favor of the Williamson method.

On the Williamson plot each plant averaged only about one-third (.346) of a pound of shelled corn; on the check plot the yield of grain per plant was almost exactly double this (.667 of a pound).

The ears were slightly larger on the check plot where the plants had greater distance, the average weight of shucked ear or nubbin being .54 of a pound as compared with an average weight of .45 of a pound on the Willimason plot. The variety used was Cocke's Prolific.

Naturally the plants with wider spacing on the check plots afforded a greater number of ears per plant, one hundred plants on the Williamson plot affording only 96 ears and nubbins as compared with 156 ears and nubbins per 100 plants on the check plot.

The average height from ground to the joint or node from which the ear or lower ear grew was 44 1-2 inches on the check plot and only 36 1-4 inches on the Williamson plot. The stalks on the Williamson plot were much more slender and broke down worse, the broken-over plants on the Williamson plot constituting 29 per cent, and on the check plot 14 per cent. This means a greater tendency for the corn to rot in the field on the Williamson plot.

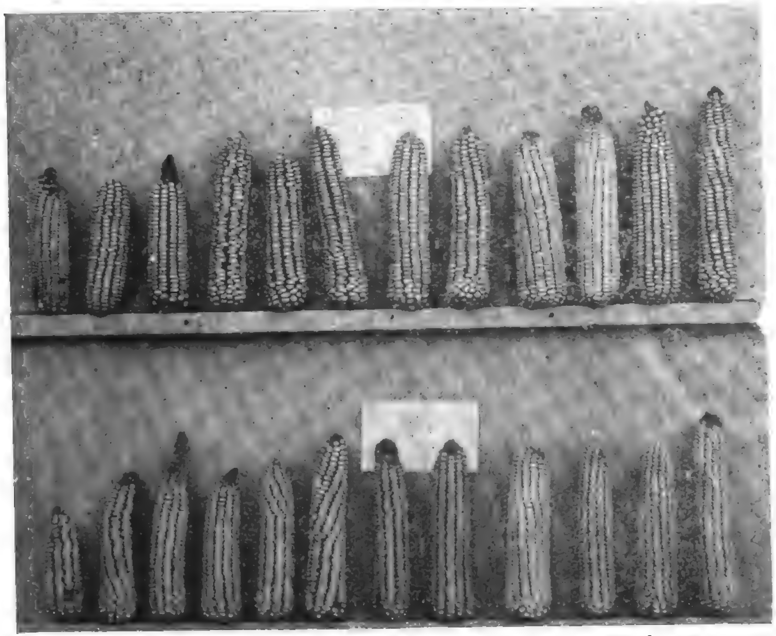

FIG. 1—*Ears and nubbins of which the average weight is the average weight for the plot.* (1, *above*) *From check plot;* (2, *below*) *From Williamson plot.*

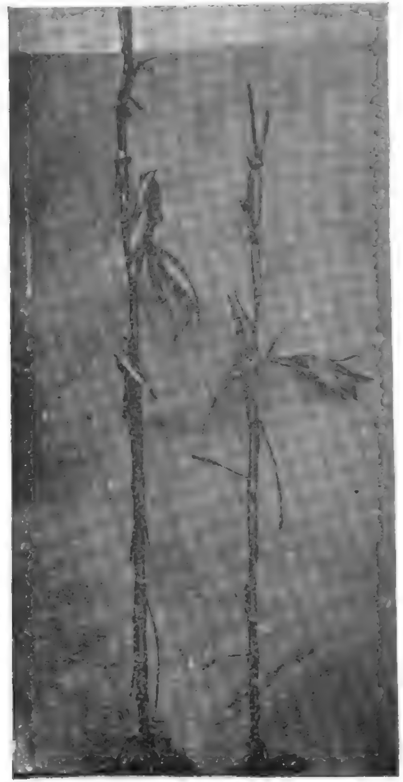

FIG. 2—*Stalks after harvest showing relative average height of ears and size of stalks; the smaller plant is from the Williamson plot.*

A study of the rainfall record for April, May, June and July indicates that at no time during the growing season did either plot suffer for moisture. The frequency of rains was doubtless favorable to the thick planting. Frequent rains at the time when cultivation of the Williamson plot was omitted prevented any injurious effect from this neglect. It is doubtful whether in average seasons such thick planting as was done on the Williamson plot (16 inches between plants) would have escaped disastrous firing.

It is obvious that we did not obtain profitable returns from this unusually large application of fertilizers; 1,000 pounds of commercial fertilizer cost $12.80, while the value of the crop at 70 cents per bushel was only $21.35. Our experiments in a number of localities in Alabama, and especially on a tract of gray sandy land similar and adjacent to that used for the Williamson experiment lead us to believe that the proportion of kainit in the Williamson fertilizer is too high.

It is an open question whether the unusually large yields obtained by Mr. Williamson on upland in South Carolina are not due more to the frequent plowing under of a crop of cowpea vines, to the liberal use of nitrogenous fertilizers, and to close planting, than to the dwarfing of the corn plant through omission of cultivation and withholding until late the application of fertilizers. Our previous experiments lead us most heartily to recommend plowing under a crop of cowpeas or other legumes as a fertilizer for corn, or the liberal use of nitrogenous fertilizers, and in many cases somewhat thicker planting than is customary, but a single year's test does not permit us to recommend all the details of the Williamson method. The experiment will be repeated, and in such a way as to inform us which of the details of the method are the really essential ones and responsible for the large yields sometimes secured.

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Agricultural Experiment Station

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AUBURN.

INJURIOUS INSECTS AND THEIR CONTROL.

By

WARREN T. CLARKE,

Entomologist

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*On leave.

INJURIOUS INSECTS AND THEIR CONTROL.

By

Warren T. Clarke.

The agriculturist, no matter what crop he may be interested in, usually finds that he has to take into account and overcome, if may be, the ravages of insect pests. Sooner or later the question of means of control is sure to present itself to him, and on the solving of this question will depend the possible profit or loss in his farm operations. An intelligent knowledge of the fundamental principles governing the study of insect pests and an acquaintance with the best and most economical ways of applying these principles becomes therefore each day more necessary. The orchardist, the grower of field crops, the truck gardener, each of these must, to a certain extent, work out the problem in his own environment. The fact recognized that some insect is destroying entirely, or greatly reducing, the value of his crop is not sufficient knowledge upon which to base remedial measures. An acquaintance with the way in which the insect makes the damaging attack is necessary, and then the general character of the remedy to be used under these observed conditions must be known for effective work to be done.

It is not in the intention nor scope of the present Bulletin to give a complete treatise on the injurious insects of this state nor to lay down rules of procedure that will be entirely applicable in every case of damage that may arise. Indeed, there are questions in the control of certain insect pests that are today not solved, so we can only at present call attention to well known principles of procedure in such cases. On the other hand, there are many such questions that have received, either here or elsewhere, an ad-

equate answer, and, in a brief way, we may call attention to certain such specific cases.

METHOD OF INJURY.

The injury done by insects to cultivated crops may, for the present and in a general way, be considered as resulting from the insect's effort to get food. There are, undoubtedly, injurious effects to the plant frequently accompanying this food-getting effort that cause more damage to it than can be laid to the mere loss of material taken by the insect. However, the primary damage, from which these other causes of loss spring, is done by the insect in feeding upon the plant. It therefore becomes of importance to know just how the insect feeds, so that the character of the damage may be understood and further, that economical and practical means of control may be applied. The insect's method of eating largely determines the character of the control means to be used. Insects feed upon plants in one of two ways, and on these feeding methods the whole series of injurious insects can be divided into two great groups. Either the insect that is causing damage to our crops has *biting mouth parts* and obtains its food by eating out portions of the attacked plant, from the fruit, the leaves, the branches and trunk, or from the roots, or it has *sucking mouth parts* and obtains its food by piercing the tissue of the part of the plant attacked, and sucking the sap. These two very different methods of feeding are readily recognizable. The work of the leaf eating caterpillars, cut-worms; the damage caused by certain leaf attacking beetles; the feeding marks of grasshoppers upon twigs and branches; the gnawing out done by mole crickets in Irish potatoes; the burrowings and minings of various borers; these forms of damage are characteristic of the work of insects with biting mouth parts. It does not require a high degree of expert knowledge to determine the facts as to eating methods in such cases as these, yet on these facts will depend, in large measure, the method of control most likely to be effective. On the other hand, we shall find that the meth-

od of attack of the insects with sucking mouth parts is quite as characteristic and easily recognized.

Poisoning.

If we determine that the insect in which we are interested, is of the biting type, devouring foliage, perhaps, then we know that it actually takes in particles of the plant as food, and we can infer that if poison is placed on this foliage it will become a part of the insect's diet and cause its death. On this determination will depend our use of such poisons as Paris green, arsenate of lead and similar toxic agents. These are known as internal or stomach poisons, are effective only when taken into the digestive tract, and do not trouble the generality of insects when in contact with them externally.

Spraying With Paris Green.—Paris green is an insoluble compound of arsenic and copper, and has received more attention and use in farm practice than has any other arsenical. If properly prepared it should carry but an extremely small percentage of free arsenic, and under these conditions it is generally not injurious to foliage, while being a very effective insecticide. It may be used as a spray in water or may be dusted on the plants or trees to be protected. When used as a spray the mixture should be made as follows:

Paris green	1 pound
Stone lime	4 pounds
Water	200 gallons

Mix the Paris green to a paste in a small quantity of water and then put in the spray tank with nearly the total amount of water to be used. Slack the lime in enough water to break it down completely, being careful, however, not to use enough water to "drown" it. Strain the milk of lime thus obtained through a sieve into the spray tank. Keep the whole mixture thoroughly and constantly stirred while spraying. In using this material as a spray, care must be exercised not to put too much upon the tree to be protected. While enough should be sprayed on to cover the leaves

and fruit with a film of the material, if the operation is continued beyond this point and dripping ensues, the leaf edges, and occasionally the entire leaf, will be destroyed by what may be termed arsenical burning. This is caused by an excessive amount of the arsenical being deposited where the running together and dripping occurs.

Dusting Paris Green.—Paris green is also used successfully in certain cases by dusting it upon the plant. This method is especially to be recommended where low growing plants, such as Irish potatoes, are to be protected from leaf-eating insects. When the dusting method is employed the poison should be mixed with some diluting material, such as hydrated lime (lime dust) flour or even fine roadside dust. The poison should be used in not greater quantity than four pounds of Paris green to fifty pounds of the dilutant and generally one half this strength will be found effective. The mixture can be successfully and economically applied to such low growing plants by placing it in a bag made of some loosely woven material and then shaking the bag over the plant that we desire to protect. The work should be done in the early morning while the plants are yet wet with dew so that the poison will stick to them. This is of course a primitive way to distribute poisons in the dust form but there are very effective dusting machines made and obtainable by those who desire more up to date appliances.

Arsenate of lead.—The arsenate of lead is also an insoluble arsenic compound and in the matter of possible damage to foliage is rather to be preferred over the Paris green. It is slightly more expensive than the latter material but requires no lime for its preparation and, when fresh, is somewhat easier to mix with water than is Paris green. It can be used as a spray at the rate of one and one half pounds arsenate of lead to one hundred gallons of water. At this rate its insecticidal value is good. Arsenate of lead is sold under various trade names and is commercially prepared for spraying purposes. It is not made in a dry form and cannot be used in the dusting method.

Poisoned Baits.—The use of arsenicals either as a spray or in the dust form is to be recommended then, in the majority of cases where the injury is distinctly caused by some leaf or twig eating insect with biting mouth parts. There are, however, exceptional cases where neither the dusting nor the spraying method will answer the purpose satisfactorily. This is especially true where so-called "cut-worms," larvæ of certain moths, are causing the damage. When our problem is the control of these insects in vegetable patches or truck gardens, then the most satisfactory results will be obtained by what are known as "poisoned baits." These depend for their killing principle upon either ordinary white arsenic or upon some one of the arsenical compounds as Paris green, London purple, or lead arsenate mixed with or put upon some food that is especially liked by the insects in question.

A quite effective poisoned bait may be made by dipping succulent leaves, such as cabbage leaves, in water in which either arsenic or some arsenic compound has been placed. The amount of the arsenical used may vary quite largely and the result still be satisfactory.

The writer has found the following proportions effective: One quarter pound white arsenic, or one half pound Paris green, to five gallons of water. The mixture should be kept well stirred and the leaves to be poisoned dipped in it. These leaves should then be placed on the ground near the plants to be protected. The work should preferably be done in the late afternoon for usually cut-worms feed in the evening and at night, and the bait will be more attractive to them when fresh. When such succulent leaves are easily obtained in quantity, the method above outlined is recommended.

In many instances, however, such leaves cannot be obtained and when this is the case a poisoned bait made as follows will be found to be thoroughly satisfactory:

Bran	40 pounds
Molasses	2 or 3 gallons
Arsenic (powdered white)	3 pounds

Water .... 5 or 6 gallons

Mix the bran and arsenic together thoroughly while dry so that the poison will be well distributed in the whole mass. Add the molasses, mixing it and the poisoned bran well together. To this add enough water to make a fairly consistent mash. When a handful of the material will hold together in a ball, not too stiffly, enough water will have been added. Spread this bait about in small heaps near the plants that are to be protected. Usually cutworms will feed rather greedily upon this material and their destruction ensues. This bait can be freshened by sprinkling a little water upon it as it lies on the ground. If Paris green is used instead of arsenic the weight of the former poison should be *five* pounds in the formula.

Caution.—Care should be exercised in all instances where arsenic or any of its compounds are used for insecticidal purposes. Domestic animals, cows, horses, swine, hens, turkeys, geese, etc., should not be allowed to feed or browse where these poisons are used. The materials should not be left where human beings might accidentally obtain a poisonous dose. No danger to human beings exists when the arsenic compounds are properly used as a spray to protect fruit or trees from insect ravages. The amount of the poison present on sprayed fruit is usually too small to constitute a dangerous factor. Obviously, no possible danger can exist so far as the edible product is concerned when poisoned baits are used.

Mechanical Methods of Destroying Insect Pests.

The use of poison sprays and baits, while generally valuable in the control of insects with biting mouth parts, is not effective in all such cases that may arise. When we have to deal with insects of this type, but which feed upon the internal parts of the plant, the use of these poisons is of no value inasmuch as it is impossible to place the poison in the situation where the insect is feeding. This restriction applies mainly to those insects known as "borers," the most destructive representative of which class that we have to deal with in this state being

the well known Peach Tree Borer. Where our problem consists of an attempt to control such pests as these, then mechanical means, so far as our present definite knowledge goes, must be resorted to. Using the insect just referred to, the Peach-Tree Borer, as representing this class of insects the mechanical means to be used, resolve themselves, finally to the actual cutting out and destruction of the individual insects. This may be accomplished by the use of very primitive tools, a good strong knife, indeed, doing effective work when properly handled or more elaborate implements may be employed. The so-called "Porter Hook," invented by Mr. C. M. Porter, of Douglas, Ga.,will be found to be one of the most effective of "worming" tools. It consists essentially of a handle some twelve inches in length into which is firmly set a curved or "hook" blade. This blade is about six inches in length, not including the shank which is inset in the handle, and is well curved so that the straight distance from base of handle to point of blade is four and one half inches. The destruction, by mechanical means, of the borers being here considered can best be done in the fall or early winter. "The larvae are at this time—some eighty-odd per cent. of them—extremely small, and are, for the most part, still on the outside of the tree feeding on such tender spots as they may have located between the ridges and crevices of the bark, and generally involved in a mass of gum and excreta. This, and most of the larvae with it, may be cleaned away by a few rapid sweeps with a steel hook" (i.e., the Porter hook or some similar implement). "The mass of gum, with its content of wriggling caterpillar life, should be thrown or jerked from the hook to a distance of several feet from the tree, in order that the larvae may find it difficult to return and be subjected to capture by predatory agencies. The process of "worming" thus executed is most expeditious and economical and may be conducted on an extensive scale with most satisfactory results."*

Whatever mechanical means may be employed for the

*Georgia Experiment Station Bulletin 73.

destruction of this or other borers, care must be exercised by the operator not to excessively wound or cut the tree. As much damage may be done the tree by careless or inefficient manipulation as would have been done by the borers that may have been destroyed in the operation.

The time above given and the method of work outlined does not, of course, apply to all the various species of borers attacking the different growths in which we may be interested. The general statement, however, may here be repeated that the work of control resolves itself into the careful cutting out, or probing for, the borer and the destruction of the individual pests and we may further emphasize the fact that the use of the arsenical poisons in such cases offers small hope of any success.

Certain injurious insects, notably the plum (or peach) curculio (*Conotrachelus nenuphar* Herbst.), have a habit of dropping to the ground and feigning death when disturbed. This habit is taken advantage of to destroy the insect. Sheets of cloth, upon light wooden frames, are placed beneath the affected trees which are then rather violently shaken or jarred. The disturbed insects fall on to the sheets and are collected from these and destroyed. The work should be done in the early morning when the insects are least active. The jarring process to be at all successful must be begun as soon as the insects are first noted upon the trees and fruit and must be continued until jarring fails to bring down enough to pay for the labor involved. This purely mechanical means of destroying these pests while being fairly satisfactory, so far as it goes, does not fully answer the question of their control. The writer has had occasion to note quite satisfactory results in controlling this pest by *spraying*. In the instance in question, the peach orchard was being sprayed with Bordeaux mixture to control the "brown rot" (Monilia fructigena.) The Bordeaux mixture was properly made by dissolving four pounds of copper sulphate (bluestone) in twenty gallons of water and by carefully slacking five pounds of clean stone lime and stirring the milk of lime or lime paste thus

obtained in twenty gallons of water. The copper sulphate solution and the lime water mixture were then poured together through a strainer into the spray tank and to the resulting Bordeaux mixture was added one pound of lead arsenate dissolved in a small quantity of water. The whole mixture was kept thoroughly stirred while being sprayed on the trees.

In the case noted this operation of spraying was repeated three times during the season and mainly to control the "brown-rot." The first application was made just before the blossoms opened and no poison added to the mixture; the second application, this time with the poison added, was made when the fruit had set, while a third application, again with poison, was made some three weeks later. The control obtained indicated considerable value in the method as above outlined. This spraying method of control, however, cannot as yet, be considered as superceding the method of mechanical control of the series of insects now being considered and until further data is at hand jarring for the curculio is the practice to be recommended.

The two methods of mechanical control of insect pests outlined in the preceding paragraphs, that is the destruction by individuals of borers and the shaking down and destroying in numbers such insects as the curculio, indicate lines of work that may have to be employed in certain specific cases. Necessarily the method of work employed will be governed by a study of the insect itself and its habits of life.

Trap Crops.

While the methods of work heretofore outlined offer means of control for many insect pests, when these methods have been adapted to the local conditions where the work is to be done, yet there are certain insects that cannot be reached by any of the ways noted. Such of our truck gardeners as are interested in the production of early tomatoes know the damage done by worms to the "bottom" or earliest crop of this vegetable. When this portion of the crop can be brought off uninjured the largest profit accrues to the grower.

The insect causing the greatest part of the loss to this portion of the tomato crop in this state, is the larval or caterpillar form of a moth scientifically known as *Heliothis obsoleta.* In the caterpillar form it is best known as the boll worm of cotton or as the corn worm. It is a destructive enemy of corn and especially of sweet corn and seems to prefer this latter to any other diet. The appearance of the larva or "worm" is familiar to all who have handled sweet corn "in the ear." This food preference can be successfully taken advantage of to control this pest in tomato fields where the saving of the "bottom" crop is a matter of importance, by planting sweet corn as a trap crop. The method to be used is as follows: Prepare the land fully four weeks before the tomato plants are to be removed from the frame and put out in the field. As soon as the land is prepared plant rows of sweet corn about twenty feet apart across the field. The corn should be planted in hills in the rows, these hills being a convenient distance apart for cultivating, so that they may not interfere with this operation after the tomatoes are set out. The sweet corn should be well up and growing before the tomatoes are placed in the field. The adult moth laying the eggs from which are produced the damage causing "worms" are attracted by the sweet corn and oviposit upon it and the tomatoes, in very large measure, escape injury. Of course no paying crop of corn need be expected under these conditions for the product will be too "wormy" to market. It will, however, have well served its purpose as a trap crop and can, at the proper time, be cut for fodder.

This "trap crop" method of controlling certain pests that are not controllable in any other way, deserves study and use upon the part of the truck gardener. It is, however, not to be considered as offering a ready means of relief in every case of insect injury that may arise.

Farm Practice.

Closely related to the "trap crop" method of control of certain insect pests, in a method that may be designated under the rather broad title of "farm practice." There are

some insects which, owing to the fact that their place and way of feeding does not admit of it, cannot be well controlled by any of the methods outlined in the previous paragraphs. In certain such cases a study of the life history of the injurious insect indicates that by changes in our time of planting and method of work we can bring on the crop before or after, as the case may be, the pest is most active and hurtful. By this means, though the insects are not destroyed, we avoid the damage that might otherwise be great. One of the insects causing damage to corn in this state is commonly known as the "bud worm." This is the larval form of a beetle known scientifically as *Diabrotica 12-punctata.* This beetle is about one quarter inch in length, is yellowish-green in color, with the wing covers marked with twelve black spots. The head and the greater part of the legs is black. It is very fond of cucurbits and is frequently found in numbers on the blossoms of such plants as cucumbers and squashes. The larva ("bud worm") is white or yellowish in color, quite slender and soft bodied. It usually feeds upon the corn roots, though, as it grows older, it may eat directly into the stalk and destroy the plant. It is from this last form of attack that it has received the name, "bud worm." It has been noted that early planted corn is most likely to suffer from the attack of this pest. The method of farm practice suggested by this fact is obviously then *plant as late as possible* to avoid this injury by the "bud worm." In this connection it is as well to say that late planting will not entirely do away with this pest. A system of rotation of crops is highly desirable where this insect is present. This rotation should not include beans or cucurbits as both of these are acceptable food for the Diabrotica. Cotton may be used in the rotation with safety. There are undoubtedly many insect pests now present in our state whose damaging work would be much lessened by some such simple change in practice as that just noted. Where the method would be applicable, however, would be a matter to be determined by the study of individual cases.

Under this heading of "farm practice" we wish to call especial attention to an insect that will in the course of three or four years be of immense importance to the cotton growers of the state. Reference is here made to the Mexican Cotton Boll Weevil, an insect which has not yet made its appearance in Alabama, but whose arrival can be predicted with a fair degree of certainty. While the exact date of the introduction of this pest to this country is not known, yet it must have come here a short time before the year 1894, when the attention of the Bureau of Entomology of the U. S. Department of Agriculture was first called to it. It was then present and harmful to cotton in some seven or eight counties of Texas. Since that time, in spite of all control efforts, it has spread over a larger and larger territory until now the limit of its eastern dispersion is within thirty miles of the Mississippi river. Besides the enormous loss to the cotton crops in the states at present most affected by this pest, Texas and Louisiana, many thousands of dollars have been spent by these states and by the Bureau of Entomology in studies of the insect and in devising ways and means of control. These studies have developed, among other important items, the fact that the Mexican Cotton Boll Weevil hibernates as an adult. This means that a certain proportion of the full grown weevils live in the cotton fields, or in adjacent situations, through the winter and from these overwintering individuals are produced the first of the new series of weevils the following spring. A further important fact is that this weevil is confined to the cotton for its food. Based on these two facts is the method of control of this pest that has proved most satisfactory and it is one of "farm practice" purely. The method is in brief, as follows: First, plant as early as can be and avoid possible frost injury, using seed of some early maturing variety of cotton. Second, by thorough cultivation and the use of fertilizers force the cotton to early maturity. Third, as soon as the crop is made remove by cutting out, raking to windrows and burning, all cotton plants. While this procedure involves a change in

practice in cotton growing in this state yet it is a change that would benefit the industry were the Boll Weevil never to get here.

By this method an excessively long period of time results in which no cotton is available as food for the weevils and the number successfully hibernating is much reduced. It is not in the intention of this bulletin to enter very deeply into the subject of the Mexican Cotton Boll Weevil. It is sufficient for our present purpose to merely call attention to the great importance of the method of "farm practice" as applied in this and similar cases of insect attack where other methods offer scanty or no relief.

Insects With Sucking Mouth Parts.

Our attention so far has been drawn to the insects that have biting mouth parts and that obtain their food by actually eating out portions of the attacked fruit or plant. There is, as was noted in our opening paragraphs, a series of insect pests whose method of eating is quite distinct and different from these so far spoken of. These insects have mouth parts so adapted, structurally, that they pierce through the outer covering of the plant or fruit attacked, and suck out the sap or juice. They do not use as food any of the outer part of the plant and as a consequence none of the poisoning methods heretofore spoken of are of any avail in their control. Another point of dissimilarity between these insects and the group designated as having biting mouth parts is that while the latter insects move about from place to place and do not, as a rule, gather together in fixed colonies, the series with sucking mouth parts have this bunching together, greg . ious habit, strongly developed. Not only is the colonizing habit characteristic of these insects but in the most injurious representatives of the group we find that when the sucking mouth parts have been inserted in the plant tissue and feeding begun the individuals remain fixed in the chosen situation throughout the balance of their lives. This habit of restricted motility, as it may be termed, is especially evident among the so-called scale insects (*coccidae*) and in the

nearly related group of insects, the plant lice, (*aphididae.*)

The methods of control that are successful with these insects are based upon this life habit of restricted motility and in the main consist of the use of what are known as "contact insecticides." These insecticides depend for their killing power, not upon the introduction of some toxic agent to the digestive tract of the insect, but upon the effect that the agency used may have upon the insect when in contact with it externally. They may be caustic in their action, actually destroying the tissues of the insect, and so bringing about its death, or they may be oily in their nature and depend for their killing power upon entering the body of the insect through the breathing pores. These are situated upon the sides of the body, and through them and their connecting tubes, (*tracheae*), air is carried to all parts of the insect's body. While the exact action of the oily sprays upon the insect's respiratory system is problematical, still the value of these sprays depends upon their effect on this system. A third class of contact insecticides depend for their value upon their tendency to loosen the insect from its situation upon the plant and permit the action of the weather upon the thus exposed pest to cause its death. Each of the methods above outlined has its value in particular cases and under certain conditions.

Control of Scale Insects.

The two pests among the scale insects causing the greatest losses in this state are the so-called San Jose Scale (*Aspidiotus perniciosus* Comst.) and the New or West Indian Peach Scale (*Aulacaspis pentagona* Targ.) The San Jose Scale is well distributed throughout the whole state while the West Indian Peach Scale is not quite so widespread in its distribution. Both insects belong in the group known as the armored scales which means that the living creature is covered over with an armor like shell which is composed of the cast skins (*exuviae*) of the insect and of a waxy material secreted by it. In both cases the individuals are extremely small and it is only their great numbers that make them a dangerous pest. It is not our in-

tention at the present time to enter into an extensive description of either of these insects. For a fuller discussion of the subject the reader is referred to Circular No. 1, issued from this department in October, 1906. It is enough to say here that the same means of control are applicable and recommended for both insects.

These consist solely of contact sprays and the one in most general use, and at present most satisfactory, is the so-called Lime-Sulfur-Salt spray. This may be made by the following formula:

Lime	30 pounds.
Sulfur	20 pounds.
Salt	5 pounds.
Water	60 gallons.

*Preparation.**—"For preparing the wash two vats or boilers are necessary, and if the spraying is to be done on a large scale, one of these, at least, should hold a couple of hundred gallons. If a smaller number of trees are to be treated, iron kettles will answer the purpose. Of course the preferable way of cooking the wash is by means of live steam.

Many ways have been suggested for mixing the materials, but the results are the same in every case, so long as the mixture has been subjected to the required amount of boiling. It is largely a matter of convenience, then, that determines the particular method, and the one found to best answer this requirement is as follows:

First, place two or three inches of water in the boiler, and to this add the sulfur, which has previously been made into a paste by mixing with hot water in order to remove the lumps, or sift the dry sulfur through a mosquito wire netting and stir in thoroughly. Then add about one fourth of the lime, and when the violent boiling has ceased add another fourth, and so on until the required amount of lime has been added. Hot water should be added with the lime as needed, so as to make the mixture a creamy consistency. Too much water will "drown" the lime while

*From Alabama Agric. Exper. Station, Circular No. 1, Oct. 1906.

on the other hand too little, will cause incomplete slaking of the lime. In this way the heat generated by the slaking lime is taken advantage of, and by adding the sulfur first, plenty of time is given for removing the lumps.

By the time the lime is thoroughly slaked the fire should continue the boiling, so that the time of boiling begins with the addition of the lime. The salt and about one-fourth of the water should now be added and the whole boiled from one to two hours, keeping it frequently stirred in the meantime. At the end of this period screen into the spray tank, add the necessary amount of *hot* water and apply to the trees hot.

The wash, when properly made, is a heavy reddish-brown liquid, very caustic and having a strong sulfur odor. The heavier materials settle upon standing, leaving a lighter liquid both in color and weight.

Application—On account of the heavier ingredients of the wash quickly settling to the bottom, means should be provided for agitating the mixture in the spray tank. This is best done, of course, by the power outfit. In the absence of this a gearing may be attached to the wheel of the wagon and the mixture agitated while going from one tree to another. A still simpler way is to stir frequently by means of a hoe or paddle.

The nozzle should be of the stopcock type, which will permit of ready cleaning. The type of spray should be a rather coarse one which will thoroughly wet the insects.

* * * * * * * * *

Thoroughness in application cannot be too strongly urged, and *no part of the tree should escape treatment.*

Time of application.—The Lime-Sulfur-Salt wash is for winter use only. It must not be used when trees are growing for very grave injury will be the result if it is applied at that time. When the trees are dormant it can be safely used upon them. Such weather conditions in the winter as will permit work in the orchard will be satisfactory for applying the Lime-Sulfur-Salt wash."

The difficulty attendant upon the preparation of this wash has led to a large amount of experimentation with

other washes. Among the many materials used in this experimental work, the so-called "soluble oils" seem to offer the most promise and where winter work with the Lime-Sulfur-Salt preparation has been impossible, then it is advisable to use this material. It is known under different trade names and under the designation, "Scalecide," a quite desirable contact insecticide is sold. The spray made with this material can be used with safety in the spring and its results, when so used, are fairly satisfactory.

The main point to be observed in the use of this and all other contact insecticides is thoroughness of application. To be effective the material must come in direct contact with the insect to be destroyed.

Plant Lice.

Another quite destructive series of insects with sucking mouth parts are the so-called "plant lice," the Aphids. These are soft bodied creatures, quite small, though generally larger than the scale insects, and are more easily destroyed than are the latter pests.

Certain species of aphids are well known to our truck gardeners, as for instance, the cabbage louse, (*Aphis brassicae*), while certain other series are quite destructive to orchard products and even to trees. When the attack of these insects is confined to the above ground parts of the tree or plant they can be quite readily destroyed by a spray made as follows: Dissolve one and one-half pounds of ordinary kitchen or laundry soap in one and one-half gallons of water. This can best be done by shaving the soap into boiling water and keeping the water boiling until the soap is fully dissolved. Remove from the fire and pour into the strong suds thus made one gallon of kerosene oil, stirring vigorously while pouring. Continue this vigorous stirring for fully ten minutes. The result should be a fairly stable creamy emulsion with no free oil. To the Kerosene Emulsion thus made add eighteen gallons of water and the spray is ready to be applied. It will be found quite effective as a destroyer of the majority of plant lice with which the grower will have to deal.

There are certain species of plant lice that attack not only the above ground portions but also feed upon the roots and root crowns of the trees. When our problem is the control of such insects as these, special methods of procedure are necessary. The best known of these pests is the Wooly Aphis of the apple—an insect that is familiar to all who are interested in the growth of this fruit. Very briefly we may say that the general method of procedure in such cases as these is to work in about the tree and root crown such materials as wood ashes or tobacco dust. These materials have a tendency to either destroy the insects or discourage their attack at the point where it is most damaging, the root crown. Special cases of this character, however, demand special study and treatment.

In the control of certain of the insects with sucking mouth parts no spraying or other method of ordinary procedure is of use and we are reduced to the practice of "hand picking" or jarring the insects off of the infested plants in our control efforts. This is true of the larger representatives of the series, as for example, the so-called "squash bug," (*Anasa tristis,*) where spraying is of little or no value and control is obtained only by the removal and destruction of the individual insects.

There are many other insects of the type with sucking mouth parts to which attention might be called but we believe the purpose of this paper is served in citing the instances above noted.

Whether the insect causing damage is of the biting or sucking type, a reasonable study of it and its activities allows us to apply remedial measures far more economically and with a greater hope of success than would be the case without this study. The purpose of this Bulletin will have been served if it brings about a closer study of the insect causes of loss in this state and a more intelligent application of remedial measures.

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Agricultural Experiment Station

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AUBURN.

Descriptions and Classification of Varieties of American Upland Cotton

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By

J. F. DUGGAR, *Director*

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DESCRIPTIONS AND CLASSIFICATION OF VARIETIES OF AMERICAN UPLAND COTTON.

By J. F. Duggar, *Director.*

REASONS FOR DESCRIBING AND CLASSIFYING VARIETIES.

The objects in view when this work was undertaken by the writer in 1899 were the following:

(1) To determine what qualities accompany large yield of lint, so that farmers might be able to choose more intelligently the best of existing varieties according to their qualities.

(2) To ascertain what characters are correlated, so as to lay a firmer foundation for rational schemes of breeding better varieties of cotton.

(3) To obtain a better understanding of the meaning of variety tests made by the southern experiment stations, by ascertaining what *qualities,* rather than what *proper names,* have usually been associated with high yield under variable conditions of soil and climate.

(4) To protect cotton farmers against the payment of exorbitant prices for seed of so-called new varieties in cases where the "novelty" was the same as some well-known old variety, seed of which could be obtained at a reasonable price.

The investigation is by no means completed and is being continued, especially to determine what characteristics may be combined in one plant and what qualities are antagonistic. The results of the first year's work in describing and classifying varieties was published in 1899 as Bulletin No. 107 of the Alabama Experiment Station The present publication includes investigation of varieties made at Auburn, Alabama, in 1899, 1902, 1903, 1904, 1905, and 1906. During each of those years collections numbering 60 to 100 so-called varieties were grown, so that the data here published usually represent the average results of tests of the same variety extending through several years. Some of the recently introduced varieties, however, have been tested only one year.

BASIS OF THIS CLASSIFICATION OF VARIETIES.

The cotton plant is very unstable, changing easily in many of its characters according to the climate and soil where it is grown. This tendency to vary with its surroundings is especially strong as regards the form of the plant, the length of the lint, and the size of the crop. Even the percentage of lint in the seed cotton varies some-

what from year to year. Moreover, the pollen may be carried from one variety to another by insects, thus producing hybrids from which still further variations arise. Because of these and other natural causes, it is to be expected that there should be numerous agricultural varieties of cotton differing from each other in slight and not very permanent qualities or characters.

Hence any attempt to classify agricultural varieties of cotton is more or less unsatisfactory. The gradations between varieties in any one agricultural character, for example, in size of boll, are so slight and gradual that positive identification of a single plant is practically impossible. However, it is believed that the averages,—for example, the average size of boll of a number of typical plants within one variety, taken in connection with the average of other qualities,—may be made the basis of a system of classification, which, though not infallible, will be useful. The classification here proposed is based, as far as considered practicable, on *groups* of qualities, rather than on a single character. Unfortunately the characteristics that are important to the farmer are those that vary most widely with change of environment.

The tentative scheme of classification here presented is practically the same as that published by the writer in 1899, in Bulletin No. 107 of the Alabama Experiment Station. A new group has been added to include chiefly varieties intermediate between the semi cluster and any other group.

UNIFORMITY NEEDED WITHIN A VARIETY.

Man has done quite as much as nature to increase the confusion as to the varieties of American upland cotton. The chief difficulty that has been encountered in the attempt to describe and classify cottons grown at Auburn under several hundred different names has been the absence of uniformity among the plants of a single variety. While this variability is partly due to natural agencies, it is also largely due to the failure of growers to avoid the mechanical admixture of the seed of other varieties, which so easily occurs at public gins. Worse still, in the case of many, perhaps most, of the so-called varieties, there has been no long period of selection through successive years with a view to fixing a uniform type.

A cotton ought to have a considerable degree of uniformity between the plants composing it before it is entitled to a name. If it is a selection from an old variety it may have this uniformity from the beginning, provided that undesirable qualities are cast out by careful selection. If the new cotton is a natural or artificial hybrid, or a mechanical mixture of two varieties, it will require at least several years of rigorous selection to secure any approach towards uniformity. Until this uniformity is secured it is neither just to the public nor advantageous of the exploiter to bestow a variety name.

It cannot be too strongly urged upon those who would originate new varieties of cotton that in selecting plants for seed they should select for the same quality or qualities every year. Stick to your ideal

year after year. If you find plants that are strong in some other quality than that you have heretofore had in mind, but different from the plants selected in previous years, either discard them or propagate them as a separate strain in a different field. Secure uniformity and special merit; until this is attained do not inflict the public with a new name and additional confusion and financial loss.

The confusion among varieties is still further increased by the renaming of old varieties, innocently or for self interest, sometimes intentionally by growers or seedsmen, sometimes by one's neighbors. This practice cannot be too severely condemned, however innocently it is sometimes done. It is to be hoped that public sentiment will hold every exploiter of a new variety morally and financially responsible that what he sells at an advanced price under a new name shall be something more than a new name.

In the long run there is more profit to the grower in the legitimate business of selecting and selling improved seed of a good and well known variety under its true name than in selling it under a new name. Here right and self-interest are on the same side.

GROUPS OF VARIETIES.

The short staple or upland varieties of cotton may conveniently be divided into seven classes, and to these may be added the long staple upland varieties as an eighth. I would propose for each of these general classes a name, giving, when practicable, an idea of the manner of growth of the plant, and with each class name would associate the name of some distinct and well known variety as a type or standard. I shall designate these groups as—

(1) Cluster varieties, or Dickson type.
(2) Semi-cluster varieties, or Peerless type.
(3) Rio Grande varieties, or Peterkin type.
(4) The King-like varieties, or King type.
(5) Big Boll varieties, or Truitt types.
(6) Long Limb varieties, or Petit Gulf type.
(7) Intermediate varieties, or various types.
(8) Long Staple Upland varieties, or Allen type.

The lines of demarkation between these groups are not always clear and distinct; one group often merges into another by almost imperceptible gradations, just as is the case with related varieties.

Below is given a list of the varieties which are included under these several groupings, and also a general description of the varieties composing each class. Some varieties are not classified, either because of insufficient data, or more frequently because badly mixed. In cases of a medium degree of impurity, or variation, description has been made of the predominant type.

GROUP I.—CLUSTER VARIETIES, OR DICKSON TYPE.

The most striking characters are (1) the extreme shortness of the fruit limbs, and (2) the tendency of the bolls to grow in clusters,

often two and even three from the same node. The plants are often tall and always slender and normally erect, though often bent down by the weight of bolls growing near the upper end of the main stem. The few base limbs are often long, or there may be no wood limbs, especially when these varieties are closely crowded or grown on poor land. The bolls and seed are usually small, but may be of medium size;—the seed are thickly covered with fuzz, which is usually whitish, with little or no brownish or greenish tinge.

As to the time of maturity these varieties must be classed as early, even though they sometimes make a second growth of bolls in the top of the plant which may fail to mature. In earliness they are surpassed by the varieties of the King type (Class IV.)

In per centage of lint they are variable, some of them equalling in this respect the Rio Grande group.

Dickson, Jackson, (also called Limbless or African), U. S. Dept. Agr. No. 128, and Welborn, belong to this group. (See illustrations.)

GROUP II.—SEMI-CLUSTER VARIETIES, OR PEERLESS TYPE.

These varieties have in less marked degree some of the qualities which distinguish Class I, being erect and having bolls borne singly very near together. Along the main stem are short fruit limbs increasing in length towards the bottom of the stem. The two to five base or wood limbs are usually of medium length. In size of bolls and size of seed and percentage of lint there is considerable diversity among these varieties. The seed are usually well covered with fuzz of many shades, whitish, greenish, or brownish. Most of these varieties are early or medium, but some that belong in both the semi-cluster and big boll groups are late in maturing. The following varieties are included in the semi-cluster group: Barnett, Berryhill, Blue Ribbon (L. S.), Cummings, Defiance, Dongola (B. B.), Featherstone, Garrard, Haralson (B .B.), Hardin, Hawkins, Herndon, Hilliard, Lealand, McCall, Minor, Montclare (B. B.), Norris, Peerless, Pullnot, Rogers (B. B.), Sterling, Tyler, and Woodfin.

GROUP III.—RIO GRANDE VARIETIES, OR PETERKIN TYPE.

The characters which most distinctly mark this class are:

(1) The large proportion of lint, usually 35 per cent. or more, of the weight of seed cotton, and

(2) Seeds of which many are bare of fuzz, except at the tip end, or so scantily covered with fuzz that the dark seed coat shows through.

The plants are well branched, and usually, on upland soil, of medium size. On many plants the stems and branches are of a deep red color. The bolls are small to medium and the seed are quite small. In time of maturing these varieties are usually neither very early nor extremely late.

The varieties included in this group are conveniently divided into two sub-groups according to the presence or absence of naked, smooth

seed. The following Rio Grande varieties have a considerable proportion of naked seed: Anson Cream, Bates, Braddy, Brannon, Cameron, Carolina Queen, Champion, Combination, Crossland, Dixie Wilt-Resistant, Gayosa(?), Mattis(?), Moss, Parker, Peterkin, Pinkerton, Ptomey, Shine Black Seed, Sistrunk, Texas Oak, Texas Wood, Victor, and Wise.

Rio Grande varieties having practically no naked seed, but having many seed so scantily clothed with fuzz that the dark seed coat shows through, giving a brown color, are the following:

Berryhill, Borden, Dearing, (probably) Eureka, Excelsior(?), Favorite, (probably) Gregg, Layton, Park's Own, Speight, and (probably) Toole.

GROUP IV.—KING-LIKE VARIETIES, OR KING TYPE.

The varieties of this group are the earliest of American cottons. The plants are usually small but may be of medium size. The limbs are numerous and the fruit limbs are rather long in proportion to the height of plant. The fruit limbs are often crooked at the joints, reminding one of the crooked twigs of a black jack oak (*Quercus Marylandica*). The base limbs are short and sometimes replaced by fruit limbs bearing a number of bolls on each. King is essentially a short jointed, compact plant with an abundance of slender, rather crooked limbs. The bolls of this group are small; the seed are usually small and thickly covered with fuzz which is usually brownish, with an occasional seed showing a greenish tint. The percentage of lint is usually 33 to 35, and sometimes higher. King and its synonyms have on many blooms a red spot near the base of the inner portion of each petal. The varieties of this group are: Dozier, Grier, Golddust, Hodge, King, Lowry, Mascot, Missionary, and probably Shine Early.

GROUP V. BIG BOLL VARIETIES OR TRUITT TYPES.

The character which especially distinguishes this class is the large size of bolls, of which only 45 to 68 are required to yield a pound of seed cotton. Other specially notable qualities are late maturity and vigorous growth of stalk. The seed are large or very large, and covered with a thick fuzz, generally brownish white or whitish, a part of the seed of many of these varieties being covered with a deep green fuzz. The per cent. of lint often runs rather low and is usually between 31 and 34. The bolls are not closely clustered; in some varieties the upper limbs are so short as to give the top of the plant the erect, slender appearance which is common among semi-cluster varieties. In typical plants the base limbs are of short or medium length, the number of fruit limbs and bolls relatively few, and the main stem is rather short. However, a number of varieties are included here that have all or many of their plants of the semi-cluster form.

The following varieties belong in this group: Alex. Allen, Anderson, Bancroft, Banks, Berry, Bohemian, Brown No. 1 (?), Cheise,

Christopher, Cleveland, Cliett, Cook Improved (?), Coppedge, Culpepper, Diamond, Double Header, Dongola, Drake (Ala.), Duncan, Ellis, Grayson, Gunn, Haralson, Hunnicutt Big Boll, Hutchinson, Jones, Langford, Lee, Maddox, Montclare, Mortgage Lifter, Ozier Big Boll, Reliable, Rogers, Rowden, Ruralist, Russell, Scogin, Sewell, Schley, Smith Improved, Smith Standard, Southern Wonder, Spearman, Strickland, Tatum, Texas Bur, Texas Storm Proof, Thrash, Todd, Triumph, Truitt, Webber-Russell, Whitten, and Wyche.

GROUP VI.—LONG LIMB UPLAND VARIETIES, OR PETIT GULF TYPE.

The varieties in this class grow to large size and have long limbs and long joints, the plants presenting a straggling appearance or want of compactness. The bolls and seed are both of medium to large size, the latter covered with fuzz of various shades. The per cent. of lint is usually low. The long limb form is usually accompanied by unproductiveness on average upland soil.

The following varieties are included in this group: Hagaman, Louisiana, Peeler, Petit Gulf, and probably Red Leaf.

GROUP VII.—INTERMEDIATE VARIETIES OR VARIOUS TYPES.

This group is here added to the scheme of classification published by the writer in 1899, primarily to include varieties having limbs a little too long to bring them within the semi-cluster class. It is also made to include a few other varieties that are intermediate between any two of the other seven groups.

To this division are assigned, Breeden, Boyd, Edgeworth, Eureka, Excelsior, Gold Standard, Hunnicutt (J. B.), Lewis, Meredith, Roby, Rosser, (probably) Shine Early, Sprueill, (possibly) Toole, Tucker, and Webber-Russell.

GROUP VIII.—LONG STAPLE VARIETIES, OR ALLEN TYPE.

The length of staple is the distinguishing characteristic. The lint usually measures 1 1-4 to 1 1-2 inches in length, or 28 to 34 millimeters or more. An almost invariable accompaniment to great length of staple is a low proportion of lint.

The plants grow to large size, have limbs of great length, and usually present a straggling appearance, though in some varieties only the base limbs are long, the upper limbs bearing a number of bolls close to the main stem, and giving the upper portion of the plant the appearance of great prolificacy.

The bolls are not very large, but are long, usually slender, tapering to a sharp point. Most of these long staple varieties are late in maturing a crop.

The seed are mostly of medium to large size, usually densely covered with fuzz, from which all trace of green is absent, the color be-

ing almost pure white, or in some varieties of a brownish tint. In some varieties the seed are bare. In this group are included—

Allen Long Staple, Allen Hybrid Long Staple, Black Rattler, Blue Ribbon, Cobweb, Cook Long Staple, Colthorp, Davis, Doughty (?), Eclipse (?), Ferguson (?), Florodora, Gholson, Griffin, Keno, Laclede, Matthews (?), Moon (?), New Century (?), Ozier Long Staple, Simms, Southern Hope (?), Sunflower, and Wonderful.

The varieties followed by an interrogation point are on the dividing line as grown on dry sandy upland soil at Auburn. On moister soil they usually have fiber long enough to admit them into the long staple group, or into a subdivision of that class which may be called the medium staple group.

PRODUCTIVENESS OF VARIETIES.

Tests of the yields of lint per acre have been made at Auburn for 90 varieties, in addition to a much larger number grown on areas too small to indicate the yield. Their rank in the production of lint each year when a "plot" test was made is shown by the figures in the following table. To compare any two varieties let the reader use only the figures for those years when both varieties entered the test.

From this table it will be seen that among the varieties tested for a considerable number of years the following are frequently near the top of the list: **Peerless, Peterkin, Russell, and Truitt.**

Among the varieties that have been tested only a few years, the following have usually taken high rank in yield of lint: **Cleveland Cook Improved, Jackson, Layton, Poulnot, and Toole**

(See detailed descriptions, illustrations of plants, and outlines of bolls, of each variety, which are alphabetically arranged on subsequent pages of this bulletin.)

The lists just given of course do not include all the productive varieties, but only those that have been notably productive at Auburn after being tested here long enough to get average results for several years. Each variety is separately described and illustrated in alphabetical order in the following pages.

TABLE I.—*Rank of varieties of cotton on the basis of yield of lint per acre.*

TABLE I.	'89	'90	'91	'91	'92	'93	'96	'97	'98	'99	'04	'05	'06
Alex. Allen	--	--	--	--	--	--	--	--	--	--	4	10	8
Allen Hybrid Long Staple	--	--	--	--	--	--	11	16	--	--	--	--	--
Allen Long Staple	2	--	8	--	21	--	--	14	--	--	14	--	--
Bailey	--	--	--	12	18	--	--	--	--	--	--	--	--
Bancroft	--	--	--	--	--	--	--	--	--	--	--	4	17
Barnett	4	--	3	--	--	--	--	--	--	--	--	--	--
Berry	--	--	--	--	--	--	--	--	--	--	--	21	--
Blue Ribbon	--	--	--	--	--	--	--	--	--	--	34	16	--
Cameron	--	--	--	--	--	--	--	--	--	--	7	14	--
Cherry Cluster	6	--	4	--	17	--	--	--	--	--	--	--	--
Christopher	--	--	--	--	--	--	--	--	--	--	--	5	12
Cleveland	--	--	--	--	--	--	--	--	--	--	--	3	3
Colthorp Eureka	--	--	--	--	14	4	--	--	--	--	--	--	--
Colthorp Pride	--	--	--	--	11	7	--	--	--	--	--	--	--
Common	--	--	--	10	--	--	--	--	--	--	--	--	--
Cook Improved	--	--	--	--	--	--	--	--	--	--	6	2	1
Cook, (W. A.) Long Staple	--	--	4	--	24	1	--	--	--	--	--	--	--
Cook, (J. C.	--	--	--	12	--	--	--	--	--	--	--	--	--
Crossland	--	--	--	--	9	--	--	--	--	--	--	8	--
Culpepper	--	--	--	--	--	--	--	--	--	--	11	16	9
Dalkeith Eureka	--	--	--	--	15	10	--	--	--	--	--	--	--
Dearing	--	--	--	--	--	--	--	4	2	14	--	--	--
Dickson	--	--	2	--	20	--	3	12	--	--	--	24	--
Dixie Wilt Resistant	--	--	--	--	--	--	--	--	--	--	--	20	18
Doughty	--	--	--	--	--	--	--	--	--	--	10	--	--
Drake ("Cluster?")	--	--	--	--	--	--	--	--	--	--	20	--	--
Duncan	--	--	--	--	--	--	9	6	--	13	--	--	--
Edgeworth	--	--	--	--	--	--	--	--	--	--	27	--	--
Ellsworth	12	--	--	--	--	--	--	--	--	--	--	--	--
Florodora		--	--	--	--	--	--	--	--	--	33	--	16
Garrard	--	--	--	--	--	--	--	--	--	--	27	--	--
Gold Dust	--	--	7	--	22	--	--	--	--	--	--	--	--
Grier's King	--	--	--	--	--	--	--	--	--	--	25	--	--
Griffin Drought Proof	--	--	--	--	--	--	--	2	--	--	--	--	--
Hagaman	--	--	--	--	--	--	--	--	--	--	--	12	--
Hawkins	9	--	9	--	16	--	8	3	--	3	15	8	7
Herlong	--	--	6	--	23	6	13	--	--	--	--	--	--
Hunnicutt, (J. B.)	--	--	1	--	14	--	12	13	--	--	--	--	--
Hutchinson	--	--	--	--	--	--	1	7	7	--	--	--	--
Jackson	--	--	--	--	--	--	--	--	--	1	3	17	--
Johnson Excelsior	--	--	--	--	--	--	--	--	--	--	28	--	--
Jones Improved	5	--	10	--	--	--	10	5	8	7	24	--	--
Jones No. 1	--	--	--	--	17	--	--	--	--	--	--	--	--
Jones Long Staple	--	--	11	--	19	5	14	--	--	--	--	--	--
Keith	--	--	5	--	11	--	--	--	--	--	--	--	--
King	10	--	--	6	8	--	5	--	--	10	17	18	5
Layton	--	--	--		--	--	--	--	--	--	2	5	2
Lealand	--	--	--	--	--	--	--	--	--	--	38	--	--
Lewis Prize	--	--	--	--	--	--	--	--	--	--	16	--	--
Lowry	--	--	--	--	--	--	--	--	--	12	--	--	--
Mascot	--	--	--	--	--	--	--	--	--	--	18	--	--
Matthews Long Staple	--	--	--	--	7	11	--	--	--	--	--	--	--
Meredith	--	--	--	--	--	--	--	--	--	--	30	--	--
Mortgage Lifter	--	--	--	--	--	--	--	--	--	--	31	--	--
Nancy Hanks	--	--	--	--	--	--	--	--	--	--	19	--	--
Okra	9	--	--	13	12	8	--	--	--	--	--	--	--
Parker	--	--	--	--	--	--	--	--	--	--	33	--	--
Peeler	--	--	--	7	8	--	--	--	--	--	--	--	--
Peerless	7	1	--	4	6	--	4	11	--	--	--	--	--

TABLE I.—(*Continued*)

	'89	'90	'91	'91	'92	'93	'96	'97	'98	'99	'04	'05	'06
Peterkin	--	2	--	5	1	--	7	8	3	4	1	12	6
Petit Gulf		-	--	3	3	--	17	--	--	--	--	--	--
Red Leaf	--	--	--	--	--	--	--	--	--	--	12	9	11
Pride of Georgia	--	--	--	--	--	--	--	--	--	--	29	--	10
Pullnot	--	--	--	--	--	--	--	--	--	--	8	5	4
Rameses	8	--	--	9	--	--	--	--	--	--	--	--	--
Russell	--	--	--	--	--	--	--	--	1	8	20	6	15
Rowden	--	--	--	--	--	--	--	--	--	--	5	--	--
Rogers	--	--	--	--	--	--	--	--	--	--	23	--	--
Schley	--	--	--	--	--	--	--	--	--	--	25	5	--
Shine	--	--	--	--	--	--	--	--	--	--	22	20	--
Simms Long Staple	--	--	--	--	--	--	--	--	--	--	9	--	--
Smith Improved	--	--	--	--	--	--	--	--	4	--	--	--	--
Southern Hope	--	5	--	8	5	--	--	--	--	--	--	--	--
Southern Wonder	--	--	--	--	--	--	--	--	--	--	--	15	--
Storm Proof	--	4	--	15	2	--	--	--	--	--	--	--	--
Strickland	--	--	--	--	--	--	--	--	--	11	--	7	--
Sunflower	--	--	--	--	--	--	--	--	--	--	34	--	15
Texas Bur	--	--	--	--	--	--	--	--	--	--	13	13	--
Texas Oak	--	--	--	--	--	--	--	1	6	6	--	--	--
Toole	--	--	--	--	--	--	--	--	--	--	--	1	3
Truitt	1	3	--	2	4	--	2	9	5	2	24	16	14
Tyler	--	--	--	--	--	--	6	15	--	9	--	--	--
Webber-Russell (U.S.D.A.)	--	--	--	--	--	--	--	--	--	--	--	--	13
Welborn Pet	3	--	--	11	13	2	15	--	--	5	--	22	--
Whatley Improved	--	--	--	--	--	9	16	10	--	--	--	--	--
Wise	--	--	--	--	--	--	--	--	--	--	5	--	--
Woodfin Prolific	--	--	--	--	--	--	--	--	--	--	23	19	--
Wonderful	--	--	--	14	16	1	--	--	--	--	--	--	--
Zellner	11	--	--	1	10	--	--	--	--	--	--	--	--
No. varieties in test	13	5	13	15	29	11	17	16	8	14	40	30	20

NO ONE BEST VARIETY.

There is no one variety of cotton that is best for all soils and for all climatic conditions. At no experiment station has any single variety maintained the first place in productiveness year after year. When fall frosts occur at an early date the earlier varieties may have the advantage. An unusually late frost may place the late varieties far in the lead.

In years when a long staple commands a premium of four to six cents, a long staple variety, in spite of its usual lower productiveness will be more profitable on suitable land than ordinary or short-staple varieties. In other years, in other markets, and on dryer land, the most productive short staple variety may be far more profitable than a long staple.

After the invasion of the boll weevil, the best cotton to grow may not be the one that now makes the largest yield, but the one that forms a large proportion of its bolls so early in the season as to insure a crop before the weevils become excessively numerous. Likewise many other conditions keep any one variety from taking a position of universal pre-eminence.

The quality that is most universally desirable in a variety of cotton is productiveness, or high yield of lint per acre. With productiveness the farmer would be glad to unite as many of the following characters as possible:

(1) Large size of boll, to facilitate picking.
(2) Length of lint, with a view to a higher price per pound.
(3) Earliness.
(4) Storm resistance or ability to hold in the burr in spite of rain and wind, provided this quality shall not be accompanied by difficulty of picking.
(5) Ease of picking, if not accompanied by excessive tendency for the seed cotton to be beaten or blown to the ground.

CORRELATION OF CHARACTERS.

Relation of size of bolls to size of seed and to production of lint.

An analysis of the tables that follow shows that generally varieties with big bolls have also large seed. Thus of the 49 varieties having bolls so large as to require only 65 bolls or fewer per pound of seed cotton, all but 9 have seed averaging above .13 of a gram, and all but three have seed heavier than .12 of a gram. Langford and Spearman are notable exceptions to this generalization, the large size of their bolls being due to the great number (respectively 46 and 49) of rather small seed.

Likewise the varieties with smallest bolls are those with smallest seed.

In the plot tests at Auburn the most productive varieties have been found a little more frequently among the varieties having small seed (usually varieties of the Peterkin type), than among the big

boll group, which, however, has been well represented among the winners.

High per cent. of lint is favorable to large yield of lint per acre, but not a necessary indication of large yield of lint. Thus nearly half of the 16 varieties having highest per cent. of lint in Table III have proved to be especially productive. In further confirmation of this conclusion we may add that the 65 varieties having lowest percentages of lint (less than 32.9 per cent.), include not a single name that has given proof of unusual productiveness. Furthermore, the long staple varieties, generally recognized as considerably less productive of lint than the best short staple varieties, have a low or very low per cent. of lint, often below 30.

High per cent. of lint is usually, but not always, accompanied by small seed. However, Cook Improved, Haralson, Dongola and Montclare are among the exceptional examples showing that it is possible to combine high per cent. of lint with rather large seed (and also with large bolls and productiveness).

Great length of fiber seems antagonistic to high per cent. of lint, All the data for the long staple varieties constitute the foundation for this deduction.

Relation of earliness to other qualities. Taking the King-like varieties as representing extreme earliness of opening, we conclude that *the qualities usually associated with earliness are small size of boll, small size of seed, short length of fiber, and medium or below medium productiveness.* Since earliness, in the greater part of the cotton belt, is chiefly important as a means of lessening the injury from the boll weevil, when it shall have occupied the entire cotton growing area, we should mark Bennett's important distinction between early opening and early setting of bolls. He regards the latter as much the more important as a means of decreasing injury from boll weevils. We might reasonably expect early setting of bolls and early opening to occur together, but on this point additional data are needed. Bennett concludes that we may identify early plants by their having short "joints" and by their lowest fruit limbs being near the ground.

NOTE. In descriptions that follow, terms describing size of bolls or seed and per cent of lint are used in the sense indicated below:-

Definitions.	*Bolls.*	*Per cent lint.*	*Size of seed.*
Large (or high)	40-68 per lb.	36 or above	.13 gram or more
Medium	69-80 per lb.	33-36	.11-.13 gram
Small (or low)	80 or more per lb.	30-33	below .11 gram

TABLE II.—*Number of bolls required to make 1 pound of seed cotton*

	Years	Bolls per lb		Years	Bolls per lb
Triumph	1	46	Sprueill Green Seed	4	67
Double Header	1	47	Breeden	1	68
Anderson	1	49	Corput	2	68
Bohemian	1	49	Grayson	1	68
Hunnicutt Big Boll	1	49	Hutchinson	2	68
Texas Storm Proof	1	50	Edgeworth	5	69
Cheise Improved	1	50	Hilliard	3	69
Todd	3	51	Rich Man's Pride	1	69
Diamond	1	52	Sprueill Re-Improved	2	69
Southern Wonder	1	52	Alex. Allen (recently 60)	4	70
Sewell	1	54	Lealand	3	70
Banks	3	56	Wilson Matchless	1	70
Spearman	1	56	Gayosa Prize	1	71
Mortgage Lifter	3	58	McCall	1	71
Bancroft	3	58	Pullnot	3	71
Strickland	2	58	Simms Long Staple	3	71
Tatum	1	58	Brannon	2	72
Truitt	5	58	Cook Long Staple	5	72
Ellis	2	59	Meredith	2	72
Christopher	4	59	Sistrunk	1	72
Japan	1	59	Best	1	73
Wyche	1	59	Blue Ribbon (fuzzy seed)	4	73
Rowden	3	60	Parks Own	2	73
Smith Standard	1	60	Warren	1	73
Brown No. 1	1	61	Red Leaf	3	73
Haralson	3	61	Carolina Queen	1	74
Holloway Storm Proof	1	61	Minor	2	74
Reliable	1	61	Nancy Hanks	3	74
Thrash Select	1	61	Rosser No. 1	2	74
Berry	2	62	Big Boll	1	75
Jones Improved	4	62	Doughty Long Staple	5	75
Rogers	1	62	Little Improved	1	75
Russell	5	62	Parker	2	75
Webber-Russell	1	62	Braswell Cluster	1	76
Cliett Improved	2	62	Florodora	3	76
Culpepper	5	63	Garrard	3	76
Dongola	3	63	Gregg	1	76
Langford	1	63	Layton	3	76
Maddox	2	63	Dixie Wilt Resistant	3	76
Drake "Cluster"	5	64	Peterkin	5	76
Duncan	1	64	Branch Long Shank	1	77
Lee Improved	2	64	Gold Standard	3	77
Ruralist	2	64	Hardin	1	77
Whitten	1	64	Hawkins Jumbo	1	77
Cleveland	3	65	Hodge	1	77
Coppedge	1	65	Mattis	3	77
Doughty Big Boll	1	65	No. 145 (U. S. D. A. selection)	1	77
Gunn	3	65	Peerless	4	77
Montclare	3	65	Pride of Georgia	3	77
Texas Bur	4	65	Wise	5	77
Cook Improved	3	66	Cummings	3	78
Griffin	3	66	Favorite	1	78
Roby	1	66	King No. 3	1	78
Scogin	3	66	Lewis Prize	3	78
Spruiell Prolific	1	66	New Century	2	78
Matthews Long Staple	2	67	Texas Oak	2	78
Schley	3	67	Bur	1	79
Smith Improved	3	67			

TABLE II.—(*Continued*)

	Years	Bolls per lb		Years	Bolls per lb
Hawkins	5	79	Ferguson	2	87
Lowry	2	79	King	4	87
Missionary	1	79	Butler	1	88
Mitchell	1	79	Borden Prolific	1	89
Moss	2	79	Cobweb	3	89
Norris	1	79	Excelsior	4	89
Ozier	2	79	Herlong	1	89
Pinkerton	3	79	Ptomey	1	89
Speight	1	79	Victor	2	89
Blue Ribbon (black seed)	4	80	Anson Cream	2	90
Todd Early	1	80	Bates Little Brown	1	90
Tucker	2	80	Shine Early	5	90
Berryhill	4	81	Black Rattler	2	91
Gholson Long Staple	2	81	Welborn	3	91
Improved Long Staple	1	81	Cameron Early	4	92
Johnson Excelsior	1	81	Toole	3	92
No. 146 (U. S. D. A selection)	2	81	Eclipse	1	93
Petit Gulf	2	81	Shine Black Seed	3	93
Boyd Prolific	3	82	Sterling	2	93
Jackson	5	82	Woodfin Prolific	1	94
King No. 1	4	82	Eureka	1	95
Bingham	1	83	Bates Poor Land	1	96
Grier	3	83	Defiance (Drake)	1	96
Dozier	1	83	Laclede	1	96
Moon	1	83	Combination	1	97
Ozier Long Staple	1	83	Colthorp	3	98
Sunflower	3	83	Mascot	2	98
Woodfin Non-Pariel	3	83	Braddy	2	99
Allen Long Staple	4	84	Early Gayosa	1	99
Crossland	3	84	Shine No. 2		100
Extra Early	1	84	Dearing	2	102
Hagaman	2	85	Dickson	3	104
Herndon Select	3	85	Keno	1	104
Texas Wood	4	85	Barnett	2	105
Allen Hybrid Long Staple	1	86	Seabrook (Sea Island)	1	112
Tyler Limb Cluster	1	86	Sea Island	3	127

Table III.—*Varieties of cotton arranged according to per cent of lint*

	Years	Per cent
Shine No. 2	1	41.5
Victor	2	40.5
Bates Little Brown	1	39.6
Wise	5	39.5
Layton	3	39.0
Cook Improved	3	38.9
Todd Early	1	38.9
Combination	1	38.8
Eureka	1	38.6
Triumph	1	38.6
Toole	3	38.5
Favorite	1	38.3
Moss	2	38.3
Haralson	3	38.2
Jackson	5	38.0
Peterkin	5	38.0
Roby	1	38.0
Berryhill	4	37.8
Braddy	2	37.8
Brown No. 1	1	37.7
Grier	3	37.7
Johnson Excelsior	1	37.7
Little	1	37.7
Bates Poor Land	1	37.6
Borden	1	37.5
Crossland	3	37.5
King No. 1	4	37.5
Whitten	1	37.4
Texas Wood	4	37.2
Blue Ribbon (wooly seed)	4	37.0
Sistrunk	1	36.9
Cameron Early	4	36.8
Montclare	3	36.8
Shine Black Seed	3	36.8
Red Leaf	3	36.8
Brannon	2	36.4
Gregg	1	36.4
Pullnot	3	36.3
King	4	36.3
Thrash	1	36.2
Rich Man's Pride	1	36.2
Pinkerton	3	36.2
Gold Standard	3	36.1
Rowden	3	36.0
Dongola	3	36.0
Carolina Queen	1	35.8
Lewis Prize	3	35.8
Mascot	2	35.8
Edgeworth	5	35.7
Rogers	1	35.7
Nancy Hanks	3	35.6
Welborn	3	35.6
Ptomy	1	35.5
Hodge	1	35.4
Extra Early	1	35.3
Anson Cream	2	35.2
Bingham	1	35.2
Cleveland	3	35.1
Langford	1	35.1
Garrard	3	35.0
Rosser No. 1	2	35.0
Maddox	2	34.9
Tucker	2	34.9
Cliett	2	34.8
Breeden	1	34.7
Culpepper	5	34.7
Pride of Georgia	3	34.7
Hawkins	5	34.6
Hilliard	3	33.6
No. 146 (U. S. D. A. selection)	2	34.5
Excelsior (Moore)	4	34.5
Hutchinson	2	34.4
McCall	1	34.4
Minor	2	34.4
Mortgage Lifter	4	34.4
No. 145 (U. S. D. A. selection)	1	34.4
Webber-Russell	1	34.4
Alex. Allen	4	34.3
Braswell Cluster	1	34.3
Christopher	4	34.3
Hagaman	2	34.3
Missionary	1	34.3
Sprueill Green Seed	4	34.3
Defiance (Drake)	1	34.2
Texas Oak	2	34.2
Double Header	1	34.1
Herlong	1	34.1
Schley	3	34.1
Smith Improved	3	34.0
Southern Hope	3	34.0
Woodfin Prolific	1	34.0
Parks Own	2	33.8
Warren	1	33.8
Boyd Prolific	3	33.7
Cheise Improved	1	33.7
Dozier	1	33.7
Speight	1	33.7
Banks	3	33.6
Calthorp	3	34.6
Branch Long Shank	1	33.6
Lealand	3	33.6
No. 149 (U. S. D. A. selection	1	33.6
Ozier	2	33.6
Holloway Storm Proof	1	33.5
King No. 3	1	33.5
New Century	2	33.5
Sterling	2	33.5
Peerless	4	33.4
Tatum Big Boll	1	33.2
Texas Bur	4	33.2
Tyler Limb Cluster	1	33.2
Herndon Select	3	33.1

TABLE III.—(*Continued.*)

	Years	per cent
Lowry	2	33.1
Dixie Wilt Resistant	1	33.1
Texas Storm Proof	1	33.1
Parker	2	33.1
Wyche Big Boll	1	33.1
Doughty Big Boll	1	33.0
Reliable	1	33.0
Todd Improved	3	33.0
Bancroft Herlong	3	32.9
Jones Improved	4	32.9
Russell	5	32.9
Truitt	4	32.9
Blue Ribbon (black seed)	4	32.8
Bohemian	1	32.8
Burr	1	32.8
Coppedge	1	32.8
Drake "Cluster"	5	32.8
Meredith	2	32.8
Moon Long Staple	1	32.7
Sprueill Re-Improved	2	32.6
Strickland	3	32.5
Berry	2	32.4
Keno	1	32.4
Mattis	3	32.4
Dickson	3	32.3
Lee	2	32.3
Barnet	2	32.2
Wilson	1	32.2
Big Boll	1	32.1
Cummings	3	32.1
Ellis	2	32.1
Gunn	3	32.1
Best	1	32.0
Shine Early	5	32.0
Woodfin	3	32.0
Spearman	1	31.9
Mitchell	1	31.8
Petit Gulf	2	31.8
Griffin	3	31.7
Early Gayosa	1	31.5
Corput	2	31.4
Matthews Long Staple	2	31.4
Florodora	3	31.3
Ozier Long Staple	1	31.3
Simms Long Staple	3	31.3
Gholson Long Staple	2	31.2
Norris	1	31.2
Ferguson	2	31.2
Hawkins Jumbo	1	31.1
Scogin	3	31.1
Black Rattler	2	31.0
Dearing	2	31.0
Laclede	1	31.0
Sewell	1	31.0
Anderson	1	30.9
Grayson	1	30.8
Hunnicutt Big Boll	1	30.8
Butler	1	30.4
Smith Improved	3	30.4
Hardin	1	30.3
Ruralist	2	30.3
Cook Long Staple	5	30.2
Eclipse	1	30.2
Doughty	5	30.1
Duncan	1	30.0
Japan	1	29.7
Sprueill Prolific	1	29.5
Davis Long Staple	2	29.2
Sunflower Long Staple	3	29.2
Diamond	1	29.1
Cobweb	3	28.3
Improved	1	28.3
Seabrook	1	28.1
Allen Long Staple	4	28.0
Allen Hybrid Long Staple	1	26.9
Sea Island	3	26.5
Gayosa Prize	1	24.9

TABLE IV. - *Weight of 100 seed; varieties arranged according to size of seed.*

	Years	Grams
Todd Improved	3	16.89
Duncan	1	16.64
Sewell	1	16.54
Bancroft Herlong	3	16.40
Banks	3	16.28
Gayosa Prize	1	16.03
Holloway's Storm Proof	1	16.03
Texas Storm Proof	1	15.98
Rowden	3	15.91
Anderson	1	15.58
Spruiell Prolific	1	15.53
Thrash	1	15.52
Double Header	1	15.34
Ellis	2	15.31
Mortgage Lifter	3	15.27
Truitt	4	15.06
Lealand	3	15.04
Strickland	2	14.96
Maddox	2	14.95
Cheise Improved	1	14.82
Southern Wonder	1	14.74
Lee Improved	2	14.46
Russell	5	14.34
Coppedge Improved	1	14.32
Rogers	1	14.30
Diamond	1	14.28
Hunnicutt Big Boll	1	14.27
Dongola	3	13.92
Cliett	2	13.87
Berry Big Boll	2	13.85
Culpepper	5	13.65
Matthews Long Staple	2	13.62
Best	1	13.55
Bohemian	1	13.54
Christopher	4	13.53
Smith Standard	1	13.49
Gurn	3	13.46
Grayson	1	13.44
Japan	1	13.44
Montclare	3	13.37
Brown No. 1.	1	13.29
Smith Improved	3	13.27
Wyche Big Boll	1	13.27
Peerless	4	13.24
Haralson	3	13.19
Jones Improved	4	13.19
Whitten	1	13.19
Drake "Cluster"	5	13.16
Sea Island	3	13.15
Blue Ribbon (fuzzy seed)	1	13.10
Branch Long Shank	1	13.06
Doughty Long Staple	5	13.06
Corput	2	12.99
Sprueill Re-Improved	2	12.82
Ozier Big Boll	2	12.75
Reliable	1	12.70
Cook Improved	3	12.68
Improved Long Staple	1	12.68
Triumph	1	12.66
Hutchinson	2	12.62
Norris	1	12.62
Doughty Big Boll	1	12.57
Braswell	1	12.36
Scogin	3	12.49
Big Boll	1	12.48
Cook (W. A.) Long Staple	5	12.48
Hawkins Jumbo	1	12.44
Sprueill Green Seed	4	12.40
Cleveland	3	12.38
Cummings	3	12.36
Rich Man's Pride	1	12.32
McCall	1	12.29
Webber-Russell	1	12.26
Alex. Allen	4	12.19
Parks	2	12.13
Texas Bur	4	12.12
Ruralist	2	12.11
Pullnot	3	12.00
Bur	1	11.98
Hilliard	3	11.88
Lowry	2	11.82
Meredith	2	11.82
New Century	2	11.81
Floradora	3	11.77
Garrard	3	11.76
Cobweb	3	11.75
Edgeworth	5	11.71
Moon	1	11.70
Tatum	1	11.61
Breeden	1	11.58
Allen Hybrid Long Staple	1	11.56
Griffin	3	11.45
Mitchell	1	11.44
Simms Long Staple	3	11.44
Ferguson	2	11.37
King No. 3	1	11.32
Schley	4	11.25
Seabrook (Sea Island)	1	11.16
Blue Ribbon (black seed)	4	11.12
Roby	1	11.10
Hawkins	5	11.07
Gholson Long Staple	2	11.06
Minor	2	11.03
No. 145 (U. S. D. A. selection	1	10.94
Johnson Excelsior	1	10.90
Nancy Hanks	3	10.88
Excelsior	4	10.84
No. 149 (U. S. D. A. selection)	1	10.84
Parker	2	10.76
Bingham	1	10.75
Warren	1	10.71
Defiance (Drake)	1	10.70

TABLE IV.—(*Continued.*)

	Years	Grams		Years	Grams
Pride of Georgia	3	10.70	Early Gayosa	1	9.78
Pinkerton	3	10.69	Ferryhill	4	9.77
Dixie Wilt Resistant	1	10.67	Colthorp	3	9.68
Ozier Long Staple	1	10.66	Hodge	1	9.69
Langford	1	10.63	King	4	9.66
Spearman	1	10.57	Texas Oak	2	9.66
Boyd Prolific	3	10.55	Wilson	1	9.62
Gregg	1	10.55	Crossland	3	9.60
Hardin	1	10.52	Dickson	3	9.59
Sunflower	3	10.52	Todd Early	1	9.58
Rosser No. 1.	2	10.44	Peterkin	5	9.52
Brannon	2	10.41	Jackson	5	9.51
Little	1	10.40	Keno	1	9.48
Petit Gulf	2	10.39	Ptomey	1	9.45
Allen Long Staple	4	10.38	Lewis Prize	3	9.43
Gold Standard	3	10.36	Black Rattler	2	9.39
Hagaman	2	10.36	Woodfin Prolific	1	9.38
Mattis	3	10.33	Dozier	1	9.33
Carolina Queen	1	10.31	Herndon Select	3	9.20
Grier	3	10.21	Mascot	2	9.13
No. 146 (U. S. D. A.)	2	10.21	Laclede	1	8.97
Texas Wood	4	10.17	Cameron Early	4	8.94
Shine Early	5	10.16	Layton	3	8.88
Red Leaf	3	10.15	Wise	5	8.72
Woodfin	3	10.11	Favorite	1	8.70
Borden	1	10.04	Toole	3	8.57
Moss	2	9.98	Barnett	2	8.56
Welborn	3	9.97	Shine Black Seed	3	8.38
Herlong	1	9.96	Tyler	1	8.36
Eclipse	1	9.94	Victor	2	8.33
Tucker Improved	2	9.92	Extra Early	1	8.26
Dearing	2	9.89	Butler	1	8.18
Anson Cream	2	9.88	Combination	1	8.17
Sistrunk	1	9.84	Bates Poor Land	1	8.16
Sterling	2	9.84	Eureka	1	8.05
King No. 2.	1	9.82	Shine No. 2.	1	8.03
Speight	1	9.82	Braddy	2	7.64
Missionary	1	9.80	Bates Little Brown	1	5.48

CONDITIONS UNDER WHICH THESE DESCRIPTIONS, PHOTOGRAPHS AND WEIGHINGS WERE MADE.

All descriptions and photographs herein published were made from typical plants grown at Auburn, Alabama, on upland fields. The soil here is sandy and dry and under these conditions the cotton plant makes relatively a small growth of stalk. The fiber of the long staple varieties is shorter here than when the same variety is grown in moister soil. Time and conditions have not thus far permitted careful and repeated measurements of fiber, and until this can be done by more accurate methods than are sometimes used, it is thought best to make no comments on the character of fiber except where the staple is distinctive. There has usually been an application of from 400 to 600 pounds of complete fertilizer per acre, and the average yield for different years has varied from about three-fourths to about one and one-eighth bales per acre. Photographs were taken about the time of first frost, and since the date of making the photographs necessarily varied, the pictures should not be taken as indicating relative earliness of varieties. Neither do the figures show the relative sizes of plants. The drawings of bolls are exactly the same size as the original boll, chosen as apparently typical of each variety.

Data as to size of bolls, weight of seed, per cent of lint, etc., are as a rule based on the average of three samples for each year that the given variety was tested, or fifteen separate samples in the case of a variety tested five years. The lint was removed by hand picking, and comparisons with percentages of lint from ginning some of the same varieties show but little difference, say 1-2 to 1 per cent higher for hand picking. The area available did not permit the growing of all varieties on plots large enough to determine the yield per acre. Where such yields were determined they are indicated in Table I.

The writer cheerfully records his obligations to those who have assisted in this work, especially to L. N. Duncan, Assistant Agriculturist, who has prepared most of the tables from our records, and has otherwise given most effective help. Among others to whom credit is due are C. M. Floyd, Superintendent of the Farm, and C. R. Hudson, formerly Assistant Agriculturist.

The writer is well aware that the plain statement of the undesirable qualities, or the failure to find conspicuous merit in a variety, may bring disappointment to the originator or exploiter and may perhaps bring censure upon the experimenter. However, conscious of entire impartiality, recognizing the possibility of errors of judgment and the limitations imposed by the small number of tests of certain recently introduced varieties, he can only present his findings with the hope that they will aid the farmer to choose the variety best for his conditions and to point out merits and defects, note of which may aid originators of new varieties still further to improve their creations.

DESCRIPTIONS OF VARIETIES.

Alex Allen.—This is a variety which A. W. Allen, Temple, Ga., states that he originated in 1898 from a single plant found in a field of mixed varieties. This is a compact, erect, big boll variety with semi-cluster form. Plants medium size, short jointed. Maturity early to medium. The bolls the last two years averaged 60 per pound of seed cotton, or larger than in our earlier tests. Storm resistance slight; per cent of lint medium or above, (34.3). Seed medium in size, fuzzy, mostly white, but some of them greenish white and some brownish white. Lint short. Rank in yield of lint in field tests at Auburn 4th, 10th and 8th. This is a promising prolific variety, useful on account of its yield, earliness, and large size of bolls.

Allen.—(Synonyms, Allen Long Staple, Allen Improved, Allen Silk, and Talbot). Originated by James B. Allen, Port Gibson, Miss., who reports it to be a cross between his Allen Hybrid and Yellow Bloom. The plants are tall with long base limbs and numerous rather short central and upper limbs. Maturity medium to late. Bolls small (84 per pound of seed cotton), or small to medium, and pointed; locks 4 or 5; storm resistance, slight. Per cent. of lint very low, (28 per cent.) Seed small to medium as judged by weight, (.104 gram), but appearing large because of abundant fuzz. Lint very long and fine. Rank in yield 2nd, 18th, 14th, and 21st. This is a well established, standard long staple variety, with excellent quality of lint and a well bolled plant.

Allen Hybrid Long Staple.—This is one of the earlier varieties originated by James B. Allen, Port Gibson, Miss., and is one of the parents of Allen Long Staple. As grown here it differed but slightly, if at all, from its descendant. The bolls are small (86 per pound of seed cotton); per cent of lint very low (26.9); seed small and fuzzy, mostly white. Maturity late. Rank in yield of lint 11th and 16th.

African.—(See Jackson).

Anderson.—Grown only in 1906. Seed received from J. F. Anderson, Williamson, Ga. This is a big boll variety with plant typical of that group, but better supplied with bolls than the average big boll variety. On type of plant this was regarded as one of the best of the big boll varieties grown at Auburn for the first time in 1906. However, the low per cent. of lint, (30.9), makes further test necessary before we can pronounce this variety a productive one. Plant medium in maturity and in height; limbs medium length; bolls very large (49 per pound), mostly five locks, opening wide. Seed very large and fuzzy, white and pale greenish white. Lint medium in length. Yield not determined.

Anson Cream.—(Synonym, probably Peterkin). Seed was obtained from North Carolina. This variety belongs in the Rio Grande group and is probably a local name for, or a selection from, Peterkin. Seed of some plants are naked, while seed of other plants,

that are probably impurities, are densely covered with whitish brown fuzz. (See Peterkin.)

Bancroft.—(Synonym, Bancroft Herlong, Jones Herlong, and probably Russell.) Seed was obtained from E. Bancroft, Athens, Ga. This old variety belongs in the big boll group, and has a rather short-limbed plant. The bolls are large, 58 per pound, long, tapering gradually to a point. The seed are large, fuzzy, deep green and brownish green. Maturity late. The leaves have the large size and relatively shallow indentations between lobes that distinguish the leaves of Russell. This variety is probably the parent of the Russell, for in size and shape of leaves, in size and shape of boll, and in color and size of seed the two are practically identical. Lint medium in length. Rank in yield of lint at Auburn 4th and 17th.

Banks.—(Synonym, Banks Big Boll). This is a big boll variety with limbs of medium length. The bolls are large (56 per pound), roundish, either blunt or abruptly pointed. Locks mostly 4. Storm resistance medium. This variety very closely resembles Truitt in form of plant, size of bolls, size and appearance of seed, and in per cent of lint (33.6); seed very large, (.163 gram), fuzzy, whitish brown. Lint of medium length. Maturity medium.

Bailey.—This variety, which was grown at Auburn about 1890-1893, is now probably extinct. As described in Alabama Experiment Station Bulletins 33 and 56, Bailey cotton had a small prolific plant, with branches of medium length, long "joints," small roundish bolls; seed small, mostly naked and black; staple of medium length; maturity early; per cent of lint very low.

Barnes.—(Synonym, Baggarly). Grown only in 1903, using seed from J. R. Banks, Newnan, Ga. There are several types of plants, one similar to Russell, another to the long limb group, and some plants resembling Peterkin. The data given in tables are from the plants resembling Russell.

Barnett.—An old semi-cluster variety now almost or quite extinct. The plants are not very uniform, and are of medium maturity and fruitfulness. The bolls are small, roundish or ovate, some of them abruptly pointed, mostly 4 locks per boll. Per cent of lint below medium (32.2), although the seed as recently obtained were small and exactly similar in appearance to Peterkin.

Bate's Little Brown.—(See Peterkin.) Seed was obtained from R. Bates, Jackson, S. C. In all important qualities this cotton is similar to Peterkin.

Bates's Poor Land.—(Synonyms, Peterkin, Bates Little Brown). Seed was obtained from R. Bates, Jackson, S. C. In all important qualities similar to Peterkin and Bates's Little Brown.

Berryhill.—F. M. Berryhill, Aline, Amite County, Mississippi, states that he originated this variety in 1898 by selection from Brannon. This variety contains some plants resembling in form Peterkin and King, but more of the semi-cluster form. The seed are small, fuzzy, mostly brownish; per cent lint 38; bolls small (81 per pound). In maturity it is medium to early; moderately prolific.

Locks mostly 5. This variety is very similar to Lewis.

Berry.—(Synonym, Berry Big Boll). J. L. Berry, Griffin, Ga., states that he originated this in 1896, from unknown parentage. This is a big boll variety. The bolls are large, (averaging 62 per pound), abruptly pointed. The per cent of lint averaged low, (32.4). The seed are large, fuzzy, mostly white, greenish white, and brownish white. In all of the qualities mentioned above Berry is similar to Truitt, but differs from the latter in being earlier. Locks 4 to 5. Storm resistance fair. Rank in yield of lint at Auburn in 1905, 21st. The most promising characteristic of this variety is its earliness for a big boll variety.

Best.—Grown only in 1903. Plants of the King form, but per cent of lint lower and size of bolls larger than that type. Maturity early. Seed greenish white.

Big Boll.—Of doubtful classification, the bolls being of medium size and too small to admit it to the big boll class, to which in other qualities it would belong.

Bingham.—Grown only in 1895. This is apparently a mixed variety, having some long limb and some almost semi-cluster plants. Seed small to medium, brownish to greenish. Locks mostly 5. Per cent of lint medium or above. Bolls small (83 per pound of seed cotton).

Black Rattler.—Seed from W. E. Collins, Mayersville, Miss. This is a long staple variety, having plants similar to Allen Long Staple. The seed are naked and the per cent of lint averaged 31. The bolls are small (91 per pound), ovate and abruptly pointed, and most of them containing 4 locks. Lint fine and long.

Blue Ribbon.—This variety was originated in 1900 by the South Carolina Experiment Station as a result of a cross between Allen Long Staple and Dickson. It is distinctly a semi-cluster variety of the long staple group, but the lint is not quite so long as the stand-and long staple varieties. The bolls are small to medium in size (averaging 80 per pound), ovate, and pointed, with 5 or 4 locks. The plant is medium to tall, abundantly fruited, compact, erect with short joints, the upper limbs short, the base limbs medium to long. Maturity, early to medium, and the earliest of the long staple group. Per cent of lint 32.8, or one of the highest of the long staples. Seed are medium size. There are two strains of Blue Ribbon differing chiefly in the fact that one has nearly naked black seed; the other, seed covered with white, or brownish white fuzz. Rank in yield of lint at Auburn 24th and 16th. The earliness, compact shape, number of bolls and length of lint make this a promising variety, and the staple should command sufficient premium to make this a competitor in point of profit with the best short staple varieties.

Bohemian.—This is a big boll variety from Texas with the characteristic shape of plants of that group. The bolls are very large, 49 making a pound of seed cotton; the per cent of lint is low (32.8); the seed are large, fuzzy, and mostly white. The lint is unusually long for this class of cotton. The plant is large and of pyramidal

shape with rather long limbs. Maturity, late. Bolls ovate and abruptly pointed.

Borden.—The high per cent of lint (37.5), small size of bolls (89 per pound), and small size of seed suggest that this may be a member of the Peterkin group. The seed are fuzzy and brownish. Seed were obtained from A. Borden, Goldsboro, N. C.

Boyd.—Seed of this old variety were obtained from H. C. Prevost, New Orleans, La. The plant is of medium size, somewhat variable, sometimes approaching the semi-cluster form, and assignable to the intermediate group. The seed are scantily covered with brownish fuzz and resemble Peterkin. Bolls small (82 per pound), 4 or 5 locks, short and roundish, sometimes abruptly pointed and sometimes blunt. Per cent of lint 33.7. Maturity early to medium. Lint, short. This variety is interesting only as being the reputed parent of a number of better varieties.

Braddy. (Synonym, Peterkin). This strain was selected by L. C. Braddy, Dillon, S. C., from a variety known locally as Simpson, which was probably Peterkin. The plant has the typical shape of the Peterkin group and has numerous, medium to long, rather slender limbs. In per cent of lint (37.8), small seed, naked or brownish fuzzy seed, this variety appears to be identical with Peterkin, though bolls were smaller (99 per pound) and a somewhat larger proportion of seed was naked in tests made at Auburn. In maturity it is medium. The plant is prolific, the type well fixed. In a publication of the United States Department of Agriculture, the statement is made that the seed are gray, and tufted, and the lint very curly.

Branch Long Shank.—M. L. Branch, Bishop, Ga., states that this has also been known under the name of Shank-High. But a comparison of the seed as grown under the first name at Auburn with seed distributed in 1907 by the United States Department of Agriculture suggests that either this cotton is wanting in uniformity or that the two names are not synonyms. The Branch seed are mostly brownish white, while the seed from the Department are mostly white with some greenish seed. The plant is tall, rather poorly supplied with limbs and bolls. The bolls have 4 and 5 locks, and are of medium size (77 per pound). The seed are large and the per cent of lint 33.6. Maturity medium. Lint short to medium.

Brannon.—(Synonym, Little Brannon and probably Peterkin). This is apparently a synonym of Peterkin, as indicated by the high per cent of lint, 36.4, small seed, most of them naked, or scantily covered with brownish fuzz. The points in which it differs from Peterkin are the larger size of bolls (72 bolls making one pound of seed cotton), and longer limbs or more straggling form of plant. It might even be placed in the long limb group.

Braswell.—(Synonym, Braswell Cluster). Seed was obtained from J. R. Pitt, Racy Mount, N. C. The plants were very variable, there being a few of a semi-cluster type and some long limbed or straggling. The semi-cluster plants had bolls of medium size, me-

dium per cent of lint; seed mostly white, and of medium size, fuzzy. In maturity the plant ranks as medium, and it is rather prolific.

Breeden.—Seed were obtained from T. C. Breeden, Lester, S. C. This is a rather tall plant, and seems to have fruit limbs a little longer than in the semi-cluster group; hence it is classed in the intermediate group. The bolls are above medium size (68 per pound), usually with five locks, oval with abrupt point. Storm resistance, good. The seeds are medium size and brownish and whitish brown colors, being of a lighter shade of brown than seed of Gold Standard.

Brown No. 1.—Seed was obtained from M. L. Brown, Bremen, Ga. In high per cent of lint (37.7), large size of boll (61 per pound), and in form of plant, which varies between typical big boll shape and tall, short limbed form, this cotton is practically identical with Cook Improved. The seed are a little larger and contain a larger proportion of dark greenish brown seed, the seed from some plants resembling Bancroft. This is a prolific variety of medium maturity.

Bur.—Bolls, medium to small, classification uncertain.

Butler.—This cotton, from North Carolina, embraced plants of several types. In maturity it ranked as medium. Per cent of lint only 30.4.

Cameron.—(Synonym, Cameron Improved). This was originated about 1895 by R. R. Cameron, West Greene, Ala. The parent varieties were Drake "Cluster" and Peterkin. The characteristics of both parent plants are plainly shown in the form of plant, some plants being of characteristic Peterkin shape, others tall with short upper limbs, and still others resembling the big boll type. At present this cotton more nearly resembles the Peterkin than the Drake "Cluster." Its high per cent of lint (36.8), small bolls (92 per pound), and small seeds, which are either naked or covered with brown fuzz, are identical with Peterkin. The bolls are mostly oval or ovate, abruptly pointed, with 5 or 4 locks. Maturity medium, storm resistance medium to poor; rank in yield of lint at Auburn, 7th and 14th. We are justified in assigning this to the Rio Grande group except a minority of the plants which show traces of other ancestry.

Carolina Queen.—(Synonym, Peterkin). Seed were obtained from J. C. Fowke, Blalock, S. C., who has selected seed of unknown origin, but which evidently must have been Peterkin. In high per cent of lint (35.8), form of plant, small seed, and the brown fuzzy covering of most seed, this plant resembles Peterkin, but differs from Peterkin only in having nearly all of its seed fuzzy, and in the slightly larger bolls (74 per pound). This may be considered as a fuzzy seed form of Peterkin, promising because of its larger bolls.

Champion.—(See Ptoney and Peterkin.)

Cheise.—This unusual name is probably a local designation for a variety of the big boll class from Texas. Bolls are large, seed large and brownish white.

Cherry Cluster.—This variety from South Carolina is probably

now extinct. From Alabama Experiment Station Bulletins Nos. 33 and 56 we learn that the plant was of medium size, compact, well limbed and prolific, resembling Peerless, but having longer limbs and joints; bolls small and roundish; seed small, fuzzy; maturity early.

Christopher.—This is said to have been originated by R. H. Christopher, LaGrange, Ga., about 1880. In form of plant, size of bolls (only 59 per pound of seed cotton), large size of seed (.135 gram), medium per cent of lint (34.3), and characteristic form of plant, this variety belongs to the big boll group. Most of the plants have the rather low, symmetrical, diffuse growth characteristic of that group. Some of them have rather short upper limbs, forming what may be called the erect type of big boll. The bolls are large (59 per pound), roundish, often blunt, and more frequently contain 5 than 4 locks. Maturity medium. The seed are large, fuzzy, and mostly brownish white, with an occasional greenish white seed. Rank in yield of lint at Auburn, 5th and 12th. This is a prolific big boll cotton, resembling Truitt in most points, but differing from the latter in having a larger proportion of roundish blunt bolls.

Cleveland.—J. R. Cleveland, Decatur, Miss., states that he originated this variety about 1885 by selecting seed from a cotton bearing no known name. The plant is tall and is well supplied with bolls and with limbs of medium or short length, tending toward the erect type of big boll plant. The bolls are large, (65 per pound) usually having five locks and falling out easily, this being the chief shortcoming of this variety. The seed are of medium size, fuzzy, brownish white, with some greenish seed .Bolls large, roundish, and pointed or bluntish. This is one of the earliest of the big boll group, ranking as early to medium. At Auburn, it has been one of the most productive of the big boll group, ranking in yield of lint, 3d in 1905, and 3d in 1906, or a little below Cook Improved.

Cliett.—Seed were obtained from R. A. Cliett, Harlem, Ga. The plants are mostly of characteristic big boll form, or in some cases of erect big boll form. The bolls are large, (63 to the pound of seed cotton), and roundish. The per cent. of lint averaged 34.8. Maturity medium. The seed are large, fuzzy, brownish white and greenish white.

Cobweb.—W. E. Collins, Mayersville, Miss., states that he originated this variety about 1878, using Sea Island and Peeler as parents. It resembles Colthorp and Black Rattler. The plant is tall, open of pyramidal form and is a long staple upland variety. The bolls are small (89 per pound), slender, long pointed, and usually having four locks. This variety has naked seed, of medium size, (.117 gram), the naked seed doubtless coming from the Sea Island parent. The per cent. of lint is 28.8. The lint is long and fine.

Cook Long Staple.—(Synonym, W. A. Cook.)

This variety is said to have been originated by W. A. Cook, Newman, Miss. The plant is medium to tall, of rather straggling or limby form, with long internodes, the plants with best fiber resembling in form Allen Long Staple. Maturity, medium to late. The

bolls are of medium size and larger than those of any other long staple tested, except Griffin, 72 bolls averaging one pound of seed cotton. The bolls are ovate, either long pointed or abruptly pointed; per cent. of lint 30.2; seed of medium size, mostly white or brownish white. The fiber is abundant and of long staple, but neither so long nor so fine as that of Allen Long Staple, and Griffin. The seed obtained in recent years has been badly mixed with some short staple variety. This is apparently one of the most productive varieties of the long staple group, having ranked in the tests at Auburn as 1st, 4th, and 24th, in different years.

J. C. Cook.—A variety of purple leaf cotton, probably now extinct or represented by some improved descendant, (See Red Leaf.) The writer, who has been unable to obtain any seed under this name, puts on record here data taken from earlier publications of the Alabama Experiment Station. In 1891 this variety was the least productive of 12 varieties tested. Its staple was very short; per cent. of lint 34.5. "Stalk, medium, pyramidal, purple. Leaves purple underneath, presenting a singular appearance. Devoid of wood limbs. Bolls round; staple very short; not prolific; very late."

Cook.—(Synonym, Cook Improved.) This variety was originated by J. R. Cook, Ellaville, Ga., in 1895. He believes it to be a natural cross between some early variety and one known locally as Beat All. In form of plant Cook cotton is somewhat variable. About 60 per cent of the plants are tall with short fruit limbs, and few medium length base limbs. The remaining plants are mostly of the diffuse big boll type with fruit limbs medium to long. The bolls are large, (66 making a pound of seed cotton), roundish, often blunt, with usually five locks. The seed cotton falls out easily, which is the point of greatest weakness in the variety. In maturity, Cook is early to medium, ranking with Cleveland and Berry Big Boll as the earliest varieties having large bolls. The bolls open well and are easily picked. The per cent of lint is very high, the average at Auburn being 38.9 per cent. This has been one of the most prolific varieties both at Auburn and at other stations. Its rank in yield of lint at Auburn during the past three years has been 6th, 2nd, and 1st. Its productiveness, large size of bolls and extremely high per cent of lint have brought this variety recently into deserved popularity.

Colthorp.—(Synonyms, Colthorp Pride, Laclede, Colthorp Black Rattler.)

Seed was obtained from Colthorp & Co., Talla Bena, La., who state that this cotton originated about 1902 from a few locks of cotton of unknown origin, having black seed and good length of staple. This is a long staple variety but as grown at Auburn the staple was not quite as long as Griffin and Allen. This cotton very closely resembles Black Rattler and Cobweb in form of plant, small size of bolls (98 per pound), naked black seed, and in character of lint. Per cent. of lint averaged for three years 33.6.

Colthorp Eureka.—(See Keno.)

Combination.—R. Bates, Jackson, S. C., states that he originated

this variety. It has a high per cent of lint (38.8) , small, fuzzy, brownish seed, and a plant similar to Peterkin. Although the plant bears many bolls, their small size, (97 to the pound of seed cotton), makes this variety worthless. This is believed to be a strain of fuzzy seed Peterkin.

Coppedge.—Seed were obtained in 1899 from C. S. Coppedge, Nyson, Ga. This is a big boll variety (65 bolls per pound) with large, fuzzy, brownish white seed. The storm resistance is fair; maturity medium.

Corput.—(Synonym, Corput Find.) This cotton as grown at Auburn for two years was too badly mixed to be described. It contained plants that could not be distinguished from Jackson, and others similar to Peterkin.

Crossland.—(Synonyms, Peterkin, Carolina Queen, Moss, Texas Wood, etc.)

In form of plant, size and shape of boll, in small seed, and in appearance of seed, which are partly naked and partly covered with a scant brown fuzz, we have not been able to find any difference between this cotton and the Peterkin variety. When tested in field plots at Auburn, its average rank in yield of lint was about the same as that of Peterkin.

Crawford Peerless.—(See Peerless).

Culpepper.—(Synonym, probably Wyche.) J. E. Culpepper, Luthersville, Ga., states that he originated this variety about 1892, using Wyche and Dickson as parents. It is now exactly similar to Wyche and shows no trace of its alleged Dickson parentage, and should probably be regarded as a selection from Wyche. In form of plant this variety is typical of the big boll group, being rather low, spreading, and having limbs of medium length. The bolls are large, (63 making one pound of seed cotton), ovate, rather blunt pointed, opening well and having very poor storm resistance. There are variously five and four locks. The per cent. of lint averaged 34.7. The seed are large and covered with a dense fuzz. Most seed are brownish white, or white, with a small proportion that have a greenish tinge. Maturity, medium, or earlier than most big boll varieties. Lint, short to medium. The plants are prolific for a big boll variety. In plot tests at Auburn Culpepper ranked about midway from top to bottom of list.

Cummings.—This is a local name in the eastern part of Alabama for a variety once quite popular and regarded as productive. It is now little grown or entirely extinct in its pure form. It is said to have been especially subject to boll rot, which is assigned as the cause of its disappearance. As grown at Auburn the plant was of medium height, and of semi-cluster or nearly semi-cluster type. The bolls are of medium size, (78 per pound), ovate, abruptly pointed; maturity, early to medium; storm resistance poor; seed fuzzy, medium size, mostly brownish white.

Davis Long Staple.—This is a long staple, rather short jointed variety. The plants are rather prolific; the staple long and fine; ma-

turity, almost as early as any of the long staples; bolls small and tapering.

Dearing.—(Synonyms, Dearing Prolific and Dearing Small Seed.) A variety apparently but little grown now. As grown at Auburn this was rather an unpromising variety of uncertain classification. Some plants were of the semi-cluster form and others were somewhat similar to Peterkin. Seed, small, fuzzy, brownish. Per cent. of lint only 31.5, although it is stated that once this variety had a high per cent of lint. Lint, short to medium. Maturity, medium.

Defiance.—(Synonym, Drake Defiance, and probably World's Wonder.)

Seed obtained from Drake Brothers, Philomath, Ga., who introduced the variety within the past few years. This is a prolific, semi-cluster, well fruited cotton, with small bolls. The plant is tall, well shaped, with short upper limbs and medium to long base limbs, resembling Woodfin and Hardin. The bolls are small, 92 average bolls being required in our test to yield one pound of seed cotton. The bolls are ovate, abruptly pointed and more frequently containing five than four locks. The per cent of lint is 34.2; seed small to medium, fuzzy, and mostly brownish white and greenish white. In maturity Defiance is early but not equal to King. The Drake cotton from Alabama has the first right to the name Drake, by reason of priority of use.

Diamond.—(Synonym, Diamond Six Lock). This is a big boll variety with low per cent of lint. Large, brownish, fuzzy seed. The lint is above medium in length; the large, roundish bolls contain mostly five locks and occasionally six locks; maturity, medium to late.

Dickson.—(Synonyms, Dickson Cluster, Dickson Improved, Dixon and Simpson). David Dickson, of Oxford, Ga., whose agricultural writings have so strongly influenced Southern agriculture, originated this variety about 1857 or 1858, by continuous selection from Boyd Prolific. This typical cluster variety was once very popular, but is no longer a general favorite. The plant is slender, erect, with numerous very short fruit limbs and several medium to long base limbs. The bolls are numerous and closely clustered. The small size of bolls (104 per pound of seed cotton) constitutes its greatest fault. The seed are small, fuzzy, mostly brownish white, and occasionally greenish white. The lint is short to medium. Most plants mature early, though not so early as King. The small bolls are ovate to roundish, and often blunt. The per cent of lint is low (32.3.) In 1905, in our variety test, boll rot destroyed more than half the bolls of Dickson, while adjacent varieties suffered only to medium extent. It was not then possible to determine whether this was due to the use of badly infected seed or to an inherent weakness in the variety. In three field tests at Auburn it ranked near the bottom of the list, and in two tests near the top of the list.

Dixie Wilt Resistant.—(Synonyms, U. S. Dept. Agriculture No. 148 and Orton No. 148). This variety is the result of successful at-

tempts to develop a variety of cotton that should be resistant to cotton wilt, also called "black heart" and "black root." Credit for originating it is due W. A. Orton, of the Bureau of Plant Industry, Department of Agriculture, Washington, D. C., who in 1901 saved seed of plants growing on the farm of M. C. Scott, near Montgomery, Alabama, that were resistant to this disease. The name of the variety from which selections were first made is unknown. Mr. Orton thinks that the Dixie is the result of accidental hybridization between this original selection and other cottons grown with it the following year. Each year it has been grown by him on infested land and seed has been saved from plants that resisted cotton wilt. While more immune than any other variety tested in comparison with it, it is not yet entirely proof against wilt, especially on land badly infested with both wilt and nematodes, or root knot worms. The plants are of medium size, having numerous medium length branches and resembling Peterkin, from which, however, it differs in having a very low per cent of lint. The bolls are small, ovate or roundish, and pointed. There are more frequently five than four locks; storm resistance is medium to good. The per cent of lint averaged 33.1. The seed are small (averaging .107 gram). The seed are variable, the fuzzy brownish seed being those preferred by the originator. Some plants have seed many of which are partially or entirely naked and exactly like Peterkin. Small green or greenish seed also occur. Lint is of medium length. In maturity this plant is medium to late. There is need for improvement in yield of lint, per cent of lint, size of bolls, uniformity of seed, and lower position of first limbs.

Double Header.—Seed were obtained in 1906 from R. H. Smith, Monticello, Ga. This is a promising big boll variety unusually well supplied with limbs and bolls. The leaves resemble Russell in size and shape. The seed also are similar to Russell and Bancroft Herlong, being very large, fuzzy, deep green and brownish green. The bolls are very large,(only 47 being required to make a pound of seed cotton as compared with 62 in the Russell variety). This evidently belongs in the Russell or Bancroft sub-division of the big boll group, but is apparently an improvement on both. The bolls are ovate, tapering and usually contain five locks; the bolls turned down, the seed cotton hanging together and showing medium storm resistance. The parts of the bur curl up. The per cent of lint is medium, 34.1; lint medium length; maturity, medium or medium to late. This variety has not yet been tested by us in such a way as to determine the yield of lint per acre.

Dongola.—(Synonyms, probably Haraldson, Montclare, Rogers and perhaps Lealand). Seed were obtained from B. F. Malabar, Waynesboro, Ga. This is a big boll variety approaching a semi-cluster, and very similar to Montclare and Rogers. The plant is tall with base limbs of medium length and short fruit limbs well supplied with bolls. It is short jointed and rather slender. The bolls are large (63 per pound), roundish, and often blunt. The seed are

large, fuzzy, and mostly brownish white. The per cent. of lint is high for a big boll variety (36). In maturity, Dongola ranks as late. The lint is of medium length.

Doughty.—(Synonym, Doughty Long Staple). We have grown this variety for five years, and have found it badly mixed. Some of the plants have the characteristic long staple form, and others more nearly resemble the big boll and straggling plants. The best type of plants have fiber scarcely long enough to admit this cotton to the long staple class, and on most plants it is plainly short staple fiber. The bolls are medium size (75 per pound), ovate, and long pointed, containing four or five locks. The seed are large, fuzzy, mostly browish white. The plant is well supplied with bolls, and in maturity ranks as medium to late. In one plot test at Auburn, Doughty ranked tenth in yield of lint.

Doughty Big Boll—This name has apparently been used incorrectly as a synonym for Doughty.

Dozier.—(Synonyms, Dozier Improved and King). This cotton from North Carolina has plants that resemble the larger specimens of King. In size and character of bolls, seed and lint, and even in the red spots on the petals, we were unable to see any difference between this and King, except that the Dozier cotton was less uniform.

Drake.—(Synonyms, Drake Improved and Drake "Cluster.") This variety is the result of selections made by R. W. Drake, Laneville, Alabama, probably from the Peerless variety. In form of plant most plants clearly belong in the big boll group, while others approach the semi-cluster type. However, the word "cluster" is misleading, for this variety is not even a semi-cluster, though well supplied with bolls. The bolls are large (64 per pound), oval, abruptly pointed and only occasionally bluntish. The seed are large, fuzzy, mostly brownish white and greenish white. Lint of medium length. This variety is entirely different from Drake Defiance.

Drake Defiance.—(See Defiance).

Duncan.—This old variety from Georgia is now nearly or quite extinct. In shape it resembles Jones and other typical big boll varieties. The bolls are large (64 per pound), ovate, or oval, and abruptly pointed or blunt, usually with 5 locks. The per cent. of lint is low; the seed are very large, fuzzy, mostly whitish brown and greenish white. In plot tests at Auburn it ranked one year at the bottom of the list and two years about midway of the list in yield per acre. In maturity it is medium to late. Lint medium in length.

Early Gayosa.—(See Gayosa).

Eclipse.—(Synonym, Eclipse Long Staple). This variety, grown here in 1902 had all the characteristics of a long staple cotton, except that it was deficient in the length of lint. This may have been due to the very dry summer which that year reduced the length of staple of most long staple varieties. The bolls and seed are small (93 bolls per pound), the seed fuzzy, and mostly brownish white.

Edgeworth.—(Synonyms, Little and Little Improved). This cotton was introduced by J. C. Little, Louisville, Ga. This variety is

difficult of classification, and is probably best assigned to the intermediate group. The plant is tall and limbs are short to medium. The bolls average medium size (69 per pound), and usually have 5 locks. The seed are fuzzy, small, mostly brownish white and greenish white, resembling King. The per cent of lint is 35.7. This is a well bolled plant of early to medium maturity. In the only plot test at Auburn it took low rank in yield of lint per acre.

Ellis.—(Synonym, Ellis Big Boll). Seed were obtained from G. B. Ellis, Palmetto, Ga. This is apparently a big boll variety with some plants approaching the long limbed type. The bolls are large (59 per pound), ovate, and abruptly pointed. The seed are large, fuzzy, mostly brownish white and greenish white. The per cent of lint is 32.1.

Eureka.—Seed were obtained from S. L. Thornton, Hartwell, Ga. Apparently this name has been applied to several different kinds of cotton. The per cent of lint of this short staple variety is high (38.6); bolls small (95 per pound), roundish; seed small and fuzzy, mostly brownish white. The variety seems to be intermediate between King and Peterkin.

Excelsior.—The cotton grown at Auburn under this name is the one originated by C. F. Moore, Bennettsville, S. C. The same name according to S. M. Tracy, has been applied to a selection from New Era, made in Georgia. The plant is similar to Peterkin, as also are most of the qualities of seed, except that there are no naked seed. The seed are small, fuzzy, densely covered with a brownish fuzz, but averaging a lighter shade of brown than the seed of Gold Standard. The per cent of lint, which in our first test was 32.8, has steadily risen to 38.1, probably due to careful selection by Mr. Moore. The bolls are small (95 per pound), oval, short, pointed. This is a prolific early to medium variety of the Rio Grande group.

Extra Early.—Seed were obtained from J. B. Crouch, Wedgefield, S. C. The plants were variable, the best being of semi-cluster type, and resembling Woodfin. The bolls are small, oval, mostly blunt. The per cent of lint is above medium. Seed small, fuzzy, brownish white.

Favorite.—Seed were obtained from S. G. Mayfield, Denmark, S. C. The form of plant, high per cent of lint, small size of bolls (78 per pound), small size of seed, and appearance of seed of many plants suggests that that is a strain of Peterkin with practicaly all the seed fuzzy, and mostly brown. The admixtures somewhat resemble King.

Ferguson.—This was received as a long staple variety, but as grown at Auburn the lint was not long enough to admit this to the long staple class. Occasionally plants were found that were practically lintless, the seed being naked and the boll almost entirely devoid of lint. The bolls are small and pointed (87 per pound). Per cent of lint 31.1; seed brownish white.

Featherstone.—Seed were obtained from J. A. Collins, Jackson, Ga. This is a variety having some plants that are quite or nearly

of the semi-cluster type, and others with longer upper limbs. The base limbs are long and too far from the ground. The bolls are of medium size, ovate, mostly with sharp points. This variety showed considerable storm resistance. Seed of medium size, mostly whitish.

Florodora.—L. A. Stoney, Allendale, S. C., states that this variety was originated by him in 1900, and that the parent varieties were Sea Island and a prolific upland cotton of unknown name. This variety has been very popular in the eastern section of the cotton belt within the past few years. The plant is tall, usually well shaped, and having the characteristic size and shape of the long staple group. The bolls are ovate and pointed and of medium size (averaging 76 per pound), and have either four or five locks. The seed are of medium size, fuzzy, white or brownish white. The per cent of lint, as usual with long staple varieties, is low (31.3). In maturity Florodora is late. The staple is long and fine on most plants, and usually commands a considerable premium over ordinary upland. Growers of this variety in this county in 1906 received a premium of 4 to 5 cents per pound, and still higher premiums have been obtained elsewhere. Where the local markets offer no premium, long staple cotton must be shipped to the seaport markets. In our field tests at Auburn, Florodora, like other long staple varieties, ranked near the bottom of the list in yield of lint per acre.

Garrard.—(Synonym, probably Hawkins), Seed were obtained from P. R. & W. T. Garrard, Nona, Ga. This is a semi-cluster cotton which in appearance of plant, per cent of lint, medium size of boll, medium size of seed, and appearance of seed was indistinguishable from Hawkins. Seed are mostly brownish white with occasionally a shade of green. The variety is early to medium, and prolific.

Gayosa.—(Synonyms, Early Gayosa and Gayosa Prize). This cotton of uncertain classification—a part of the plants probably belonging in the Rio Grande, and part in the short limbed groups—was notable in our tests for its low per cent of lint. Bolls are small (71 per pound.) Some of the plants had naked seed like Peterkin.

Gholson.—(Synonym, Allen Long Staple). This is a selection from Allen Long Staple made by L. K. Gholson, Fort Deposit, Alabama. This cotton is similar in all respects to Allen Long Staple, which see.

Gold Dust.—(See King.)

Gold Standard.—Seed were obtained from Excelsior Seed Farm, Bennettsville, S. C. This variety is of doubtful classification, for it contains plants that in turn suggest the semi-cluster, the Rio Grande and the King group. Generally it is a rather compact, erect, almost semi-cluster plant with base limbs of medium length. The bolls are small to medium (77 per pound), mostly roundish. The per cent of lint is high (36.1); maturity, medium. This is a rather prolific variety, the most distinctive feature of which is the deep brown or yellowish brown color of fuzz, which densely covers the seeds of many plants.

Grayson.—(Synonyms, Grayson Big Boll, Grayson Early Prolif-

ic). Classification doubtful; bolls medium to large; low per cent of lint. Seed are large, mostly brownish white.

Gregg.—This variety is stated to have been originated about 1900 by S. A. Gregg, Florence, S. C., from a single plant found in a garden. The plant somewhat resembles Peterkin, but the fuzzy seed, mostly brownish white and greenish white, make the classification of this variety doubtful. The bolls are of medium size, mostly ovate and pointed. The per cent of lint is high.

Grier.—(Synonyms, Grier's King and King). Seed were obtained from L. F. Grier, Oxford, Alabama. This cotton was identical with King in all respects, including the red spot at the base of each petal.

Griffin.—(Synonym, Griffin Long Staple.) This long staple variety was originated by the late John Griffin, Greenville, Miss., about 1867 as the result of repeated crossing between Sea Island and the Old Green Seed. Selection has been continued each year since then by the originator or by his son. At present selection is being made with a view to fixing the 5-lock quality, while maintaining the length and fineness of fiber. As grown at Auburn, the Griffin plant was not prolific. The lint is longer and finer than that of any other upland variety tested by the writer, but the fiber lacks uniformity of length; even the shortest fibers are full long for the long staple class. The staple is weak, and the outer part of the lock has often a characteristic glossy sheen. Maturity, late; bolls medium to large, and larger than any other long staple (66 being required to make one pound of seed cotton). Locks 4 and 5; per cent of lint, 31.7. Seed mostly brownish white or whitish brown; medium size.

Griffin Drought Proof.—This short staple variety from Georgia, is different from Griffin Long Staple. Per cent of lint low.

Gunn.—Seed were received from C. L. Gunn, Temple, Miss. This is a large plant of the Petit Gulf or long limbed type, though it might equally well be ranked as a large spreading form of the big boll group. The bolls are large (65 per pound), oval, abruptly pointed. The seed are fuzzy, mostly white, but with some mixture of deep green seed. Per cent of lint 32.1.

Hagaman.—Prof. H. J. Webber states that this variety originated near Jackson, La., and was probably a selection from one grown under the name of Dean, though Peeler, which it resembles, was the kind grown almost exclusively on the owner's plantation at the time. The form of plant varies somewhat, and is nearer to the long limbed than to any other group. Bolls small (85 per pound), ovate, pointed; seed small and on some plants brownish white and on others partly naked. Per cent of lint 34.3.

Haralson.—(Synonym, Dongola, which see.)

Hardin.—Originated by B. B. Hardin, Washington, Ga., who exhibited at the Macon Fair in 1906 single limbs almost completely hidden by the thickly clustered open bolls. Receiving no reply to letters addressed to the originator, we secured our seed through a firm in Montgomery, Alabama. As grown here in 1906, Hardin was

a semi-cluster variety very similar to Woodfin and Sterling, but not bearing bolls in dense masses. The bolls were numerous and from medium to small in size (77 per pound of seed cotton), and the per cent of lint 30.3. The small seed are partly white and partly greenish white.

Hawkins.—(Synonyms, Hawkins Improved and Hawkins Jumbo). Originated by W. B. Hawkins, Nona, Ga. This is a standard semi-cluster variety, and the plant is usually prolific and of good shape. The medium to small bolls (79 per pound) are often roundish. The per cent of lint is 34.6. The seed are fuzzy, mostly brownish white and greenish white. Maturity, early to medium; lint, short to medium in length. In plot tests at Auburn it ranked in yield of lint 9th, 16th, 8th, 3rd, 3d, 15th, 8th, and 7th.

Hawkins Jumbo.—(See Hawkins.)

Herlong.—A variety entirely different from Bancroft was tested once. It had small bolls and small seed. (See also Bancroft.)

Herndon.—(Synonym, Herndon Select). This is a selection made by J. A. Herndon, Elberton, Ga., from an accidental stalk resembling the Dickson. The Herndon is almost a semi-cluster variety, with small bolls (85 per pound); small brownish white seed; and early to medium maturity. Per cent of lint 33.1.

Hodge.—(Synonyms, King and probably Dozier). This cotton from North Carolina has medium to small bolls; early maturity; small greenish white and brownish white seed. In form, the plant somewhat resembles the larger plants of King.

Hilliard.—This is a semi-cluster variety very near to the big boll class, with medium to large bolls (69 per pound); per cent of lint, 34.6; rather broad semi-cluster form of plant; medium size of seed, fuzzy, and chiefly brownish white. Maturity early to medium.

Holloway Storm Proof.—(Synonyms, Storm Proof and probably Rowden). A big boll large seed variety.

Hunnicutt.—(Synonym, Hunnicutt Choice). This was a variety originated by the late Dr. J. B. Hunnicutt, of Georgia, who several years ago wrote me that he believed the variety then to be extinct. This was a variety with medium to long limbs; bolls medium size, fuzzy, roundish, brownish white seed.

Hunnicutt Big Boll.—(Synonyms, probably Russell and Bancroft). The plants are similar to Russell. This cotton has recently been selected by J. A. Hunnicutt, Warsaw, Alabama. The bolls are very large, the seed large, fuzzy, brownish green and deep green, exactly resembling Russell, from which it is probably a selection. The per cent of lint is low and maturity late.

Hutchinson.—This big boll variety was obtained from J. N. Hutchinson, Salem, Ala. The bolls are large, ovate, abruptly pointed, showing considerable storm resistance. The seed are fuzzy, medium size, mostly brownish white with some greenish white.

Improved Long Staple.—This is in the long staple group with small bolls, fuzzy, brownish white, medium sized seed.

Jumbo.—(Synonym, Hawkins.)

Jackson.—(Synonyms, African and Limbless.)

This variety, which a few years ago was largely exploited, is a tall, cluster cotton, resembling Welborn Pet, but having larger bolls and lint adhering to the burs more firmly. The bolls are mostly borne in clusters near the main stem. There are usually one or two medium to long base limbs, but these are sometimes wanting and sometimes more numerous. The bolls are small, (82 per pound), ovate, tapering. Per cent of lint high, (38); seed fuzzy, small, mostly brownish white. At Auburn it ranked in yield of lint 1st, 3rd and 17th. This is a productive variety but with serious faults of form, height, tendency to shed and difficult to pick.

Jackson Wilt Resistant.—(Synonym, U. S. Dept. of Agriculture, No. 128.)

This is the result of selections made since 1900 by W. A. Orton, of the U. S. Department of Agriculture, from plants of the Jackson variety that withstood cotton wilt. It is resistant but not entirely immune.

Japan.—This big boll variety with large, fuzzy, white seed was obtained from a Texas seed firm and is probably a local name for some better known Texas variety.

Johnson.—(Synonym, Johnson Excelsior.)

This cotton is wanting in uniformity of type, containing plants resembling Peterkin, others like the big boll group, and some of semi-cluster form. The bolls are small, 81 per pound; the per cent. of lint high, (37.7); the seed small, fuzzy, and varying in color from pure white to a yellowish brown.

Jones.—(Synonyms, Jones Improved, Jones Re-Improved, and Schley.)

This is a standard big boll variety originated by J. F. Jones, Hogansville, Ga., probably from Duncan. The bolls are large, requiring 62 bolls per pound of lint. The bolls are pointed; the large seed are mostly white, also brownish and greenish white. Per cent. of lint, low. Maturity late. In seven years' tests at Auburn it was usually below the middle of the list and never higher than fifth in yield of lint.

Jones Long Staple.—This long staple is described as having a large, straggling, non-prolific, late plant, with large tapering bolls; large, fuzzy, brownish white seed. Staple long; per cent of lint very low.

Keith.—Tested at Auburn prior to 1894 and reported in Bulletins Nos. 33 and 56 as a prolific, short limbed, and apparently semi-cluster variety, with roundish bolls of medium size; seed of medium size, fuzzy, white or brownish white; maturity early; per cent. of lint, low; staple short.

Keno.—This is a selection made from Colthorp Eureka about 1895 by Colthorp & Co., Talla Bena, La. In form of plant and silkiness of staple it probably belongs in the long staple group, but as grown at Auburn the lint was of scant length for long staple. Bolls are

very small, (104 per pound); per cent. of lint, (32.4); seed fuzzy, small, mostly brownish white.

King.—(Synonyms, King Improved, Gold Dust, Tennessee Gold Dust, King No. 2, King No. 3, Grier, Mascot, Hodge, Dozier, etc.)

This very distinct variety was originated in Louisburg, N. C., by T. J. King, about 1882-4, from several plants selected by him as superior to the parent varieties, which latter he declines to name. The King in form of plant is taken as a distinct group, with plants characterized by small size, short base limbs, numerous medium length upper limbs, the longest of which are sometimes crooked, the growth reminding one of the limbs of a black jack oak (*Quercus Marylandica.*) On part of the blooms there is a red spot inside the flower and near the base of each petal. The most valuable quality of this variety is its extremely early maturity. We have found no other so early. This makes it a favorite in regions where the boll weevil is present. Its popularity on this account is somewhat offset by the small size of bolls and by the shortness of staple. The per cent. of lint is high, almost equalling the Peterkin group. The seed are small, fuzzy, mostly greenish white and brownish green. The bolls are roundish or ovate, sometimes blunt. The seed cotton falls out easily. Occasional plants are found of large size, but in other respects these retain the characteristics of the King variety. In 8 years' plot tests at Auburn it was usually about the middle of the list and never above fifth in yield of lint per acre.

Layton.—A selection made by R. D. Layton, St. Matthews, S. C., from a mixed cotton. In form of plant, high per cent. of lint, (39), medium to small size of bolls, (76 per pound), and small size of seed, this variety belongs in the Rio Grande group, but it differs from Peterkin in that practically all of the seed are fuzzy. Most of them are brown or brownish white, some greenish white, the darker seed resembling the fuzzy seed occuring in the Peterkin variety. Like Peterkin, Layton has but slight storm resistance. There are usually five locks. Layton is medium in maturity and has proved at Auburn one of the most productive of the Rio Grande group, ranking in yield of lint per acre, second, fifth and second, among all varieties tested in plots in 1904, 1905, and 1906, respectively.

Langford.—Seed from S. J. Langford, Albin, Ga. This is a big boll variety. The plants are short jointed and approach the semi-cluster form, and are medium in maturity. The seed are fuzzy and small to medium; per cent. of lint 35.1. Bolls, 63 per pound.

Lealand.—Seed from H. P. Jones, Herndon, Ga.

This is a semi-cluster variety with roundish, mostly blunt bolls, above medium size, (70 per pound.) The seed are large, fuzzy, mostly brownish white and greenish white, but in some plants resembling Bancroft. In maturity Lealand is medium; per cent. of lint, 33.6. Although the plants are of pleasing shape and fairly well bolled, yet in a single test here Lealand ranked at the bottom of the list in yield of lint per acre.

Lee.—Seed from E. E. Lee, Wildwood, Alabama. This is probably

a local name. It represents a big boll variety with ovate, pointed bolls; large, fuzzy, brownish white and greenish white seed.

Lewis.—(Synonyms, Prize, Lewis Prize.)

W. B. F. Lewis, Lewiston, La., states that he originated this variety. This is a plant of the erect, short-limbed type, with few short base limbs, or none, and characterized by some plants having near the base crooked fruit limbs, curving downward and bearing four, five, or more bolls. The photograph represents a plant of this type without base limbs. The bolls are medium to small, (78 per pound), ovate or roundish, pointed. The seed are fuzzy, small, mostly brownish white, and greenish white, the brownish seed resembling those of Layton. The per cent. of lint is 35.8. The fibre is rather short. In a single plot test at Auburn it stood just above the middle of the list in yield of lint per acre.

Limbless.—(See Jackson.)

Little.—(See Edgeworth.)

Laclede.—(See Colthorp.)

Louisiana.—This cotton from Louisiana is a large, straggling, long limbed plant with small bolls. It is a late variety and probably belongs in the Petit Gulf group.

Lowry.—Seed originally from J. G. Lowry, Cartersville, Ga. This is an early variety similar to King. The bolls are small, (79 per pound); the seed are medium size, mostly greenish white and brownish white. Per cent. of lint 33.1.

Maddox.—Seed obtained from J. S. Maddox, Orchard Hill, Ga. This is a big boll variety with fuzzy seed, some of which are greenish white and some brownish, the latter with only a scant covering of fuzz. It has large, ovate, pointed bolls, (63 per pound), large seed, per cent. of lint 34.9; maturity medium.

Mascot.—In all respects this proved identical with King, which see.

Matthews.—(Synonym, Matthews Long Staple.) This Mississippi variety, now nearly or quite extinct, is nearer to the big boll than to the long staple class. The lint is too short and the bolls too large for the long staple group. The bolls average 67 to one pound of seed cotton. The seed are large, fuzzy, white; maturity medium. Per cent. of lint 31.4.

Mattis.—Seed from C. F. Mattis, Learned, Miss. The plant was similar to Peterkin, but perhaps larger. The bolls are medium in size, (77 per pound), oval, pointed, with slight storm resistance; maturity medium; seed are small, black and naked. This seems to be a rank growing form of Peterkin with lower per cent. of lint, (32.4.)

Parker.—This cotton was originated by John M. Parker, Sr., in Bolivar County, Miss., about 1868. This belongs in the Rio Grande group as judged by form of plant, size of boll and size of seed. It differs from Peterkin in having somewhat more fuzz on the dark brown to brownish white seed, and in having a lower per cent of lint, 33.1. The bolls are small to medium, (75 per pound), ovate, and slightly pointed. The seed are small to medium; maturity medium.

At Auburn, Parker was less productice than Peterkin and had slightly longer limbs.

Mebane.—(Synonyms, Mebane's Triumph; Triumph, which see.)

Meredith.—(Synonym, Meredith Big Boll.)

Seed from J. C. Meredith, Jenkins, Ga. This variety can probably be classed as belonging to the intermediate group. The plant has one to three short base limbs, is medium to tall, and has ovate, pointed, medium sized bolls, (72 per pound). The seed are medium sized, mostly brownish white and greenish white. The per cent. of lint is 32.8; maturity medium. In a single plot test at Auburn it stood near the bottom of the list in yield.

McCall.—This is a semi-cluster variety of no conspicuous merit from South Carolina. The bolls are of medium size, (71 making a pound of seed cotton), ovate or roundish, and pointed. The per cent. of lint is 34.4; the seed are of medium size, fuzzy, mostly brownish white.

Minor.—Seed from J. J. Minor, Toomsboro, Ga. This is a semi-cluster variety, with rather long upper limbs for this group. The bolls are of medium size, (74 per pound of seed cotton), the per cent. of lint 34.4; seed of medium size, fuzzy, brownish white, brownish, and greenish. Maturity medium to late.

Missionary.—(Synonym, probably King, which see.)

The plants, though lacking in uniformity, resemble the larger plants of King and other qualities also accord with those of King.

Mitchell.—(Synonyms, Mitchell Twin Boll and Clark Prolific.)

H. B. Mitchell, Athens, Ga., states that he originated this variety about 1895. The classification of this variety is uncertain. Bolls are medium to small, (79 per pound); the seed medium in size, fuzzy, brownish white and brown.

Montclare.—E. M. Williamson, Montclare, S. C., states that this variety was originated by him about 1891, probably as a selection from Jones Big Boll. This rather promising variety belongs both in the big boll and in the semi-cluster groups, and closely resembles Dongola and Rogers. The bolls are large, (65 per pound); roundish, often blunt, and usually contain five locks. The per cent. of lint is high for a big boll variety, averaging 36.8. Maturity, late.

Moon.—(Synonym, Moon Long Staple.) In form of plant this variety from Arkansas resembles most long staple varieties. In our test the length of lint was not quite sufficient to place this in the long staple group. The bolls are small, (83 per pound), the seed small to medium, fuzzy and white. Per cent. of lint 32.7.

Moss.—(Synonyms, Moss Improved, Peterkin, etc.)

This is a selection from Peterkin made since 1887 by B. D. Moss, Norway, S. C. This cotton could not be distinguished from Peterkin in size and appearance of seed, bolls and plants.

Mortgage Lifter.—It required 58 bolls of this big boll variety to make one pound of seed cotton. The bolls are ovate to roundish, and pointed. The seed are large, fuzzy, mostly white, with some brown-

ish white and some greenish white. The per cent. of lint is 34.4; maturity, late; lint, medium to long.

Nancy Hanks.—This cotton, which lacks uniformity, is of doubtful classification. Some plants resemble the short limbed group, others the big boll group. The bolls are small; seed mostly fuzzy, and brownish white; per cent. of lint, 35.6.

New Century.—The form of plant resembles the long staple group, but the lint, though long for a short staple, was on our dry soil, too short for a long staple. The bolls are small to medium, ovate pointed, with usually 4 locks. The seed are medium to large, white and brownish white. Per cent. of lint medium; maturity medium to late.

Nonpariel.—(Synonyms, Woodfin, Woodfin Nonpariel, Sam Woodfin Prolific. See Woodfin.)

Norris.—Seed from H. H. Steiner, Grove Town, Ga. This is a semi-cluster variety with small bolls and a very low per cent. of lint. Seed are large and mostly brown and greenish brown. Maturity, medium to late.

Okra.—(Synonyms, Okra Leaf, Forked Leaf.) Now probably extinct. It is characterized by leaves having very narrow lobes, thus making the foliage surface relatively small. Limbs, long; length, between joints, medium; bolls small and tapering; seed of medium size, fuzzy, white; staple short; "Prolific for a long limbed variety."

Orton.—Nos. 128, 145, 149. (See U. S. Department of Agriculture.)

Orton.—No. 148. (See Dixie Wilt-Resistant.)

Ozier Long Staple.—(Synonyms, Ozier, Ozier Silk, Ozier Starnes. Tennessess Silk, Bob Silk, Bob White, Bob.)

Seed from J. D. Ozier, Corinth, Miss. This is a rather prolific variety of the long staple class. The bolls are small, ovate, and long pointed, with 4 locks. The staple is long and fine, but shorter than that of Allen Long Staple. Seed small to medium, fuzzy, white and brownish white; per cent lint low. Maturity medium.

Ozier Big Boll.—Seed from J. D. Ozier, Corinth, Miss. The seed received under this name produced somewhat variable offspring, most plants belonging in the big boll group, with roundish bolls, often blunt, and usually five locks. Seed fuzzy, large, mostly white, brownish white and green. Per cent. of lint medium; maturity, late.

Parks Own.—Seed from G. F. Parks, Alexander City, Alabama. A local name given to a strain of fuzzy seeded Peterkin, that is no longer kept distinct.

Peeler.—Described in Alabama Experiment Station Bulletins Nos. 33 and 56 as a large, straggling, non-prolific, late variety, with long, drooping, long jointed limbs; medium to large, tapering bolls; seed large, fuzzy, brownish; per cent of lint, low.

Peerless.—(Synonyms, Crawford Premium, Crawford, etc.) This variety, once popular, is now rarely grown. This variety belongs in the semi-cluster group. The bolls are of medium size, ovate, abruptly pointed, with slight storm resistance. Seed are fuzzy, large, and

variable in color, mostly a brownish white. Per cent of lint, 33.4; maturity, medium.

Petit Gulf.—This very old variety, now probably almost or quite extinct, belongs in the long limbed group. The plant is large, straggling, long jointed, with slender limbs, often turning downward from the weight of bolls. As we grew it in 1899 and 1903, probably in mixed condition, the variety was practically worthless. The bolls are small, mostly ovate, and either abruptly pointed or obtuse, having both 4 and 5 locks. The seeds are of medium size, mostly fuzzy, greenish and whitish brown. Some of the small fuzzy seed are green. Maturity, late; lint, long for a short staple; per cent lint, 31.8.

Peterkin.—(Synonyms, Audrey Peterkin, Brazier Peterkin, Crossland, Carolina Queen, Moss, Peterkin Limb Cluster, Texas Wood, Wise, etc.) This widely grown variety was originated by J. A. Peterkin Fort Motte, S. C., about 1870. As the result of continued selection by the originator, it is now one of the most uniform of all varieties. Plants are of medium to large size, abundantly supplied with branches, which are usually straight; base limbs numerous, and short to medium in length; upper limbs medium to long. The bolls are of medium size (averaging 76 per pound of seed cotton), ovate, pointed, opening wide, usually with five locks, which rather easily fall out. Maturity medium. The seed are small, more than half of them naked and black, except for a tuft of fuzz at the smaller end. The other seed are scantily covered with brownish fuzz. This variety is characterized by a rather high per cent of lint. Lint is above medium in length. In ten years in plot tests at Auburn it occupied respectively the following positions in yield of lint per acre: 2nd, 5th, 1st, 7th, 8th, 3d. 4th, 1st, 12th and 6th. No variety tested for so long a period has proved more productive, though some newer varieties tested only a few years are slightly ahead for those few years.

Pinkerton.—Seed from H. R. Pinkerton, Eatonton, Ga. This variety was lacking in uniformity of seed, but seemed nearest to the Rio Grande group. Maturity, medium. Bolls, small, (79 per pound); seed small; per cent of lint, 36.2.

Pride of Georgia.—(Synonym, Malier Prolific). Seed from J. H. Malier, Sunny South, Ga. This Georgia variety is said to have originated about 1895. It is of doubtful classification, the plants lacking uniformity, some having the semi-cluster form. The bolls, which are ovate, and pointed, vary from large to medium. The seed are small to medium, fuzzy and mostly brownish white and greenish white. Maturity, medium. Per cent lint, 34.7.

Prize.—(See Lewis.)

Ptomey.—(Synonyms, Champion, Peterkin, etc.) This is doubtless a local name in one neighborhood in Alabama for Peterkin, which it resembles in all respects.

Pullnot.—Seed from J. E. Bradberry, Athens, Ga. This is a semicluster variety. The bolls are of medium size, or above, (71 per

pound of seed cotton), ovate or roundish, and often blunt, with either 4 or 5 locks. It has but slight storm resistance. The seed are of medium size, averaging .12 of a gram, fuzzy, brownish white and brown, with a few deep green seed. This is a very promising prolific variety of medium to late maturity. In three plot tests at Auburn it ranked 8th, 5th, and 4th, or always in the upper quarter of the list in yield of lint per acre. The per cent of lint is high, (36.3).

Purple Leaf.—(See Red Leaf and J. C. Cook).

Rameses.—An old variety no longer grown. Apparently it was a semi-cluster variety, resembling Peerless. It is described in Bulletins Nos. 33 and 56 of this Station as having long base limbs; upper limbs long but short jointed; plant prolific and early; bolls roundish and of medium size; seed medium, brownish white; staple short.

Red Leaf.—(Synonyms, Willett Red Leaf, Willett Purple Leaf). Seed from N. L. Willett Seed Co., Augusta, Ga. This is a unique variety, leaves, stems, squares and bolls being a deep purple. The new blooms are pink instead of white. The plant is large and very ornamental. In shape it is somewhat like a large, long-limbed, long staple variety. The base limbs are numerous, usually 3 to 5, long and growing more nearly upright than in most varieties. It has been claimed that this variety is exempt from cotton rust and some other diseases. At Auburn it has been slightly attacked by rust, but is apparently somewhat more resistant to this disease than most varieties, and retains the leaves better under adverse conditions. In maturity it is late to very late. Storm resistance, slight. The bolls are of medium size (73 per pound of seed cotton), roundish, short pointed, with either 4 or 5 locks. Per cent of lint high (36.8); lint medium or above medium in length. The seed are small, fuzzy, brownish white, due to the black color of seed coat showing faintly through the rather scanty covering of white fuzz. The plant is rather long jointed and not very prolific in proportion to size. In three plot tests at Auburn it ranked in yield of lint per acre, 12th, 9th, and 11th. In color of foliage this plant resembles a cotton grown at the Alabama Experiment Station in the early '90's, under the name of J. C. Cook, (which see).

Reliable.—Seed from E. S. Rakestraw, LaGrange, Ga. This is a big boll cotton, resembling Truitt in size of bolls, which are large and pointed, in form of plant, which varies between typical big boll and the semi-cluster form; and in appearance of seed, which are whitish brown and greenish brown. In a single test, the seed were medium to large or a little smaller than seed of Truitt. Maturity late. Per cent lint, 33.

Rich Man's Pride.—Seed from E. W. Bond, Athens, Ga. Classification uncertain, plants having few base limbs of medium length, few short upper limbs; bolls above medium size, ovate, pointed; medium maturity, fuzzy seed, mostly brownish and greenish. Per cent of lint, high.

Roby.—Seed from J. E. Roby, Goodman, Miss. This variety seems to be intermediate between the big boll and the long limbed group. In a single test at Auburn it was considered promising on account of prolificacy, high per cent of lint, and rather large bolls, (66 per pound of seed cotton). The plants are large, abundantly supplied with limbs and bolls; both lower and upper limbs are long. Seed fuzzy, medium size, very variable in color, from brownish white to deep brown, with an occasional deep green seed.

Rogers.—Originated about 1890 by R. H. Rogers, Darlington, S. C., as the result of crosses between (1) Jones Improved, (2) a small bolled, storm-resistant, "cluster" form of Herlong, and (3) Jowers, the latter a small round boll, very prolific cotton. This variety belongs both in the big boll and the semi-cluster groups, and resembles Dongola and Montclare. The bolls are large (62 per pound of seed cotton), decidedly storm resistant, and have 5 and 4 locks, not opening wide. The bolls are roundish, pointed or blunt. The seed are large, brownish white, and greenish. Per cent of lint above medium; maturity, medium to late.

Rosser No. 1.—This variety of uncertain classification is apparently intermediate between the King and the big boll group. It has medium sized, ovate, pointed, bolls; seed mostly brownish, fuzzy, and small. In prolificacy, maturity, and storm resistance, it is medium. Per cent of lint is above medium.

Rowden.—This variety, which originated in Texas, belongs in the big boll group (60 bolls making one pound of seed cotton). The bolls are ovate, pointed, relatively storm resistant, the locks, mostly 5, hanging together in a compact mass, making picking easy. Per cent of lint above medium; maturity medium; lint, medium length. This variety has many valuable qualities, but has the weakness of having a small number of bolls, and an insufficient number of limbs. In a single field test at Auburn it stood 5th in yield of lint among 40 varieties tested. It is one of the favorite varieties in the boll weevil region of Texas.

Ruralist.—This variety was originated a few years ago by J. F. Merriam, Battle Creek, Ga. This is a big boll variety averaging in two years' tests 64 bolls per pound of seed cotton. The bolls are ovate, pointed, opening well; the per cent of lint is low; the seed are of medium size, mostly brownish white, brown and green. Maturity, medium.

Russell.—(Synonym, probably Bancroft.) This variety was originated about 1897 by J. L. Russell, Alexander City, Alabama, from a single chance plant of unusually thrifty growth and having very large bolls, found in his field. It has become a wide favorite, and probably divides the honors with Peterkin and Truitt of being the variety most extensively grown in Alabama at present. The plants are of medium size, having two to four base limbs of medium length, upper limbs of short to medium length. The leaves are characterized by large size and shallow indentations between the lobes. The bolls are large (averaging 62 per pound of seed cotton), long, ovate, tapering gradually to a point, opening well, and easily picked. The

per cent of lint is below medium (32.9). The seed are large, densely covered with fuzz, either green or greenish brown. In maturity, Russell is late. In field tests at Auburn its rank in yield of lint per acre was 1st, 8th, 20th, 6th, and 15th, averaging about midway of the list for the years when it was tested. It stood ahead of Truitt three years and was beaten by Truitt two years. In all points, including characters of plants, foliage, seed, and yield, Russell and Bancroft Herlong have been practically identical. While no historical or documentary evidence has been found bearing on the point, my opinion is that Russell and Bancroft are identical, the Russell probably being a selection from a chance plant of Bancroft, found in Mr. Russell's field. This view is supported by the similarity in all points and by the further fact that, excepting a few strains exploited within the past few years, no other varieties have been found having the unique seed characters common to Bancroft Herlong and Russell.

Rust Proof.—Noted in Alabama Experiment Station Bulletin No. 56 as having large bolls, low per cent of lint. No longer obtainable under this name.

Sam Woodfin Prolific.—A selection from Woodfin and identical with the parent variety.

Seabrook.—This is a variety of Sea Island cotton (see above) originated by F. P. Seabrook, James Island, S. C. Among Sea Island cottons it is classed as a medium grade of staple and hard to gin on the gins commonly employed for that class of cotton, on account of some green fuzz on the seed. It is regarded as productive for this class of cotton, and better suited than most Sea Island strains for cultivation in the interior. The seed, averaging .11 gram and 26 per boll, are mostly naked and black, except for a tuft of greenish brown fuzz at each end of the seed. The per cent of lint was 28.1; bolls per pound of seed cotton 112. It did not mature its entire crop at Auburn.

Sea Island.—This belongs in a different species from the short staple and long staple upland varieties, being classed by botanists as *Gossypium barbadense.* The plants are very large and have long slender limbs; stems and leaves are free from hairiness. The bolls are very small and slender, tapering gradually to a sharp point; surface of bolls pitted. The leaves are entirely unlike those of short staple and long staple upland varieties, the lobes (usually 5) being separated by deep indentations. At Auburn the Sea Island matures only a small portion of its forms. The young bloom is cream colored instead of white, and has a red spot inside the flower, near the base of each petal. The per cent of lint is very low, averaging at Auburn 26.5; it required 127 bolls to make one pound of seed cotton. The seed, which are naked and black, were of large size (.13 gram), and the average was only 21 seed per boll. Lint very long, fine and silky.

Scogin.—(Synonym, Culpepper, which see). A selection made by

J. F. Scogin, Luthersville, Ga., from Culpepper, from which it cannot be distinguished.

Sewell.—A local name for a big boll, unprolific, large-seed variety with low per cent of lint. Seed mostly brownish white.

Shine.—(Synonyms, Shine Early, Shine No. 1, etc.) Originated by J. A. Shine, Faison, N. C., about 1875, who states that it is descended from Sea Island and from a little known variety called Micasucie. This is an early variety, but not quite so early nor so uniform as King. Some of the plants are of the short limbed type and some of them resemble King. This variety is inferior to King in per cent of lint (averaging only 32 per cent), and in two tests at Auburn, in which it was compared with King, the yield of lint was lower. Storm resistance, poor; bolls small (90 per pound); seed small, fuzzy, brownish white and greenish.

Shine No. 2.—This cotton, of variable type and uncertain classification, was originated by J. A. Shine about 1900, who states that its parent was Texas Bur.

Shine Black Seed.—(Synonyms, Hood and probably Peterkin.) This cotton is evidently a selection from Peterkin, which it resembles in all points.

Schley.—This is a selection from Jones Improved made by the Georgia Experiment Station. In one of our tests it exceeded and in another test fell below its parent in yield of lint per acre. It belongs to the big boll class, and is perhaps a little more erect and compact than its parent. The selection has increased the per cent of lint (34.1) and slightly decreased the size of seed, has made maturity earlier, and the form of plant more compact.

Simms.—(Synonym, Simms Long Staple). Seed obtained from J. F. Weekley, Wheeler, S. C. This long staple variety had bolls of medium size, medium sized seed, mostly fuzzy and brownish. The plants were not productive. Maturity, medium to late.

Sistrunk.—This is a selection made by W. E. Sistrunk, Tallassee, Ala., beginning at a time when he was growing both Crossland and Hawkins varieties. As grown in 1905 it had not become entirely uniform, but the majority of plants had the Rio Grande characteristics, being evidently mostly selections from Crossland. The bolls are of medium size (72 per pound); per cent of lint high (36.7); seed small (.098 gram), mostly with a scant covering of a brownish fuzz. Plants prolific, and of medium to late maturity.

Smith Improved.—Seed from A. J. Smith, Conyers, Ga. This is a big boll variety with large fuzzy seed, which are brownish white and greenish white.

Smith Standard.—(Synonyms, Ben Smith, and Smith Choice, Bush). A big boll variety with large fuzzy seed and medium per cent of lint, medium maturity.

Southern Hope.—Seed from Marx Schaefer, Yazoo City, Miss. In shape of plant this is a typical long staple. The bolls are medium size, ovate, pointed. The staple is short for the long staple group. Per cent of lint is 30.6. Bolls medium size, 78 making a pound of

seed cotton; seed small to medium, fuzzy, white and brownish white; maturity medium.

Southern Wonder.—Seed from L. F. Grier, Oxford, Alabama. This is a big boll variety (52 bolls per pound), with medium per cent of lint, large, fuzzy ,brownish white, brown, and green seed. If is moderately prolific and of medium to late maturity.

Spearman.—(Synonym, Spearman Choice). Seed from W. B. Spearman, Social Circle, Ga. This is a big boll variety of medium maturity; plants compact and moderately prolific, approaching the semi-cluster form. The bolls are large (56 per pound), roundish, often blunt pointed. The seed are smaller than those of most big boll varieties, averaging .106 gram. The seed are fuzzy, mostly brownish white. The per cent of lint is low (31.7).

Speight.—Seed from J. B. Speight, Winterville, N. C. Classification uncertain, but probably it represents a form of the Rio Grande group; plants prolific, well shaped and suggesting Peterkin; bolls small, ovate; seed small, variable, either fuzzy, brownish white, greenish, or brown, or nearly naked. Per cent of lint 33.7, or very low for the Rio Grande group.

Spruiell.—(Synonyms, Spruiell Re-Improved, Spruiell Green Seed, Spruiell Prolific). Originated by A. M. Spruiell, Leeds, Alabama, as a selection from Hutchinson. We have grown this cotton from the originator for several years under each of the above names, and have found the strains to be practically the same, the differences between the different strains being less than the differences between the individual plants of the same strain. This seems to be an intermediate between the big boll group and the King group. The bolls are above medium size (61 to 72 per pound, averaging 67 for the three strains), ovate, pointed. In maturity it is early to medium, or earlier than most varieties with bolls of this size. Further improvement in the matter of uniformity is needed. Seed, medium to large, fuzzy, whitish brown, greenish brown, brown and green.

Sterling.—Seed from L. W. Dance, Eatonton, Ga. This is a prolific semi-cluster cotton of early to medium maturity. It resembles Woodfin and the more compact, erect plants of Hawkins. Bolls small (93 per pound), ovate, sometimes obtuse, seed small, mostly brownish white. Lint short to medium in length; per cent of lint, medium.

Storm Proof.—(See Texas Storm Proof.)

Strickland.—Originated by J. R. Strickland, Gordo, Ala. This is a big boll variety, with plants typical of that group. The bolls are large, (58 per pound), ovate, usually blunt-pointed. The per cent of lint is low, (32.5). The seed are large, fuzzy, mostly brownish white. Lint above medium. In two plot tests at Auburn, Strickland ranked 7th and 11th in yield of lint per acre. This variety very closely resembles Truitt.

Sunflower.—Seed from Marx Schaefer, Yazoo City, Miss. This is a long staple variety with plants, bolls and fibres typical of that group. The bolls are small, (83 per pound of seed cotton), slender,

tapering to a sharp point and having either 4 or 5 locks. The plant is prolific for a long staple variety. Storm resistance medium. Seed small to medium, white and brownish white. Maturity medium to late. Fiber long; per cent. of lint, low, (29.2).

Like the other long staple varieties it has stood near the bottom of the list in yield per acre of lint at Auburn, about equalling Florodora.

Tatum.—(Synonym, Tatum Big Boll.) Seed from R. D. Tatum, Palmetto, Ga. The plants are well shaped and characteristic of the big boll group. Bolls large, (58 per pound), abruptly pointed. Per cent. of lint, 33.2; seed, large, fuzzy, brownish white and greenish white. Maturity, late. This variety resembles Strickland, but has a larger per cent of greenish seed, which average smaller.

Texas Bur.—Originated by C. E. Smith, Locust Grove, Ga., by selections since 1895 from an unknown variety originally from Texas. This is a big boll variety, with rather few medium length limbs, and medium maturity. Per cent. of lint, low. Seed of medium size, fuzzy, mostly brownish white, but with some greenish seed. In two plot tests at Auburn it ranked in yield of lint per acre about one-third the distance from the top of the list. On account of its apparent earliness for a big boll variety this cotton is worthy of preservation and improvement through an increase in the number of limbs and bolls.

Texas Oak.—(See Peterkin.) A variety of the Rio Grande class and identical with Peterkin, but having a lower per cent of lint, (34.2.)

Texas Storm Proof.—(Synonyms, Bahama, Drought Proof, Storm Proof). A big boll variety with medium per cent of lint; very large, fuzzy seed, (.16 gram), mostly brownish white. Some of the seed obtained under this name contained nearly or quite naked, black seed like Peterkin. Bolls very large, pointed; storm resistance considerable; maturity, late.

Texas Wood.—This is similar in all respects to Peterkin, which see.

Thrash.—See Wyche.

Todd.—(Synonym, Todd Improved). Seed from P. W. Todd, Grantville, Ga., who states that it originated about 1892 by selection from a field where "storm proof" and two other varieties were planted. This is a typical big boll variety with very large bolls, (51 per pound), bolls ovate, pointed, and usually with five locks. The per cent of lint is medium (33). Seed very large, (.169 gram), fuzzy, mostly whitish brown, but with some greenish seed. Maturity late; fairly prolific.

Todd Early.—Distinct from above; small bolls; classification uncertain.

Toole.—Originated by W. W. Toole, Augusta, Ga., in 1894 as a selection from Peterkin. It is probably an intermediate form between the Rio Grande group and the King group, being much closer to the former. In a few plants were found red spots on pet-

als, pointing to kinship to King. This is a very prolific variety. The plants are of medium size, symmetrical and abundantly supplied with bolls and limbs. The bolls are small (88 averaging in our tests one pound of seed cotton). The bolls are ovate, abruptly pointed, with five or four locks, opening wide and allowing seed cotton to fall out rather easily. The seed are small (only .086 gram), a part of them quite fuzzy and pale brown, but most of them appearing dark brown by reason of the very scant covering of white or brownish fuzz, through which the dark seed coat can be seen indistinctly. The per cent of lint is very high, (averaging 38.5). In maturity Toole is early or early to medium, being later than King and a little earlier than Cook. It has proved more productive than King or Peterkin, standing 1st and 3rd in two field tests at Auburn, or about equal to Cook. Its principal defect is the small size of bolls. Its earliness and productiveness should make it a favorite, especially after the appearance of the boll weevil.

Triumph.—(Synonyms, Mebane, Mebane Triumph). This variety was originated by Mr. ——— Mebane in the southern part of Texas, but our seed were obtained from J. L. & W. B. Myrick, Lott, N. C. This is a big boll variety, with immense bolls, only 46 bolls being required to make a pound of seed cotton. Other conspicuous merits of this variety are the facts that it is earlier than most big boll cottons, ranking as medium in maturity, and that it has a very high per cent of lint, (38.6 in our test). The seed are numerous, of medium size, (averaging .127 of a gram), fuzzy, brownish white and greenish. This cotton is somewhat resistant to storms; lint, of medium length or above. The yield of lint was not determined at Auburn, only a small area of this variety being grown. While not especially well bolled here, this variety has enough merit to make it a favorite in case its yield of lint in our 1907 test shall equal that of other leading varieties. This variety has been especially satsfactory in regions infested with the boll weevil.

Truitt.—(Synonyms, Truitt Big Boll, Truitt Premium). This is a popular and widely grown big boll variety, originated by George W. Truitt, LaGrange, Ga., by selection from the so-called "Old Georgia White Seed." The bolls are large (averaging in four years' tests, 58 per pound of seed cotton). The plants are well shaped and more prolific and more nearly approaching the semi-cluster type than do many of the big boll varieties. Bolls are large, ovate, pointed, opening wide, and not storm resistant. Seed large, fuzzy, mostly brownish white to white. Maturity, late, but not quite so late as Russell. This variety has been tested in plot experiments at Auburn for eleven years and ranked in yield of lint in the respective years 1st, 3rd, 2nd, 4th, 2nd, 9th, 5th, 2nd, 24th, 16th, and 14th.

Tucker.—(Synonym, Boyd.) Seed from W. B. Tucker, Opelika, Ala., who selected it from Boyd Prolific. Plants variable, mostly short-limbed; per cent of lint 34.9; bolls small; seed small, fuzzy, brownish white, brown and greenish; maturity, early to medium.

Tyler.—(Synonym, Tyler Limb Cluster). This is a semi-cluster

variety from South Carolina, which is now probably extinct. Bolls small; seed like Peterkin; but per cent of lint only medium.

U. S. Department of Agriculture Nos. 145, 149.—These are selections made on account of wilt resistance by W. A. Orton. They have all been discarded because inferior in this point to Dixie and to U. S. D. A No. 128, below.

U. S. Department of Agriculture, No. 128.—(Synonym, Jackson Wilt Resistant). A selection from Jackson Limbless made by W. A. Orton since 1890, with a view to increase its resistance to cotton wilt.

Victor.—(Synonyms, Combination, Peterkin, etc., which see). A strain of Peterkin from South Carolina that is abundantly supplied with bolls, the small size of which (89 per pound), makes it inferior to the parent. The seed are very small, brown, mostly fuzzy.

Warren.—Seed received from J. B. Warren, Moscow, Miss. Classification uncertain; not especially promising.

Webb.—This cotton from North Carolina includes two types, one is semi-cluster and one resembles the larger plants of King. Early, but otherwise unpromising.

Webber-Russell.—A hybrid made by Dr. H. J. Webber, between Russell and some long staple variety. As tested in 1906 it had most of the characteristics of Russell, but smaller leaves, large, slenderer, and more pointed bolls, many white seed as well as the usual large green seed; fibers of unequal length on the same seed. It would not yet take rank among the long staple varieties. In a single test the yield of lint was slightly above that of Russell.

Welborn.—(Synonym, Welborn Pet.) A cluster variety now difficult to obtain, originated by the late Jeff Welborn, of Texas. Plants of medium height, consisting of a central stem with very short fruit limbs and one to four base limbs of medium length. Plant resembles Jackson, but the bolls are slightly smaller, (91 per pound) and less tapering; bolls ovate, thickly clustered, abruptly pointed. Maturity, early, but later than King. A peculiarity of this variety was the opening of most of its bolls about the same time. Per cent of lint above medium.

Whatley.—A local name in Lee County, Alabama, for a strain that is no longer maintained.

Whitten.—(Synonym, Whitten "Cluster.") A local name in the eastern part of Alabama for a big boll variety that seems to be a selection from Cummings or Peerless. Bolls, large, pointed; seed large, fuzzy; per cent lint, high; the plant resembles the so-called Drake "cluster" from Alabama.

Wilson.—(Synonym, Wilson Matchless). Seed from F. D. Wilson, Littleton, N. C. Classification uncertain. Bolls medium size, ovate, pointed, usually 5 locks; wood or base limbs one to five, of medium length. Per cent of lint low, (32.2). Seed small, fuzzy, brownish white and greenish white. Maturity, medium.

Wise.—(Synonym, Peterkin, etc., which see.)

Seed from H. P. Jones, Herndon, Ga. The plant in all qualities

is not distinguishable from Peterkin, though in five years' tests it averaged 1 1-2 per cent higher in per cent of lint (39.5) and the seed averaged slightly smaller (.087 gram). It is possibly a few days later than Peterkin.

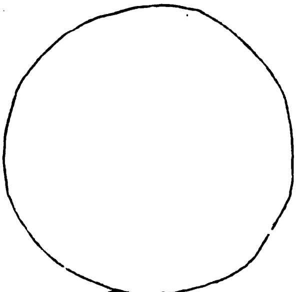
Wonderful.—An old long staple variety no longer obtainable. Described in earlier bulletins of this Station as having a large plant, with long, drooping, long-jointed limbs; bolls large, and pointed; maturity late; staple long; seed large, fuzzy, brownish white.

Woodfin.—(Synonym, Nonpariel.) Originated by S. V. Woodfin, Marion, Alabama, about 1898, who states that the parent varieties were Peerless, Peterkin, and one that he calls Senegambia. This is a well shaped plant of the semi-cluster type. The bolls are small, ovate, pointed, with either five or four locks. Maturity medium, to late; per cent of lint low to medium; seed small, fuzzy, mostly brownish white and greenish. This cotton is identical with Sam Woodfin Prolific and closely resembles Sterling and the most compact plants of Hawkins.

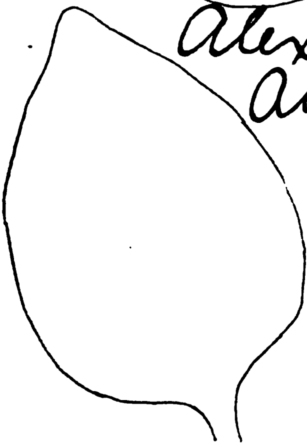
World's Wonder.—(Synonyms, Probably Defiance and Drake's Defiance; see Defiance.)

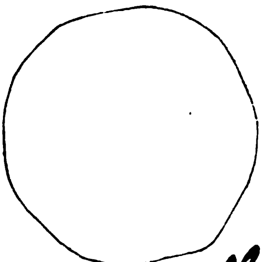
Wyche.—(Synonyms, Wyche Big Boll, Thrash). Seed received from J. S. Wyche, Wooster, Ga. who states that this variety originated there about 1873. This is a typical big boll variety, 59 bolls making a pound of seed cotton. Per cent of lint medium; bolls ovate, pointed, and with either five or four locks. The seed are large, mostly white or brownish white. Wyche resembles Jones Improved.

Zellner.—Extinct. Described in Alabama Experiment Station Bulletins Nos. 33 and 56 as having a plant of medium size; bolls roundish, of medium size; early; per cent of lint very low; staple short. This was apparently a semi-cluster variety.

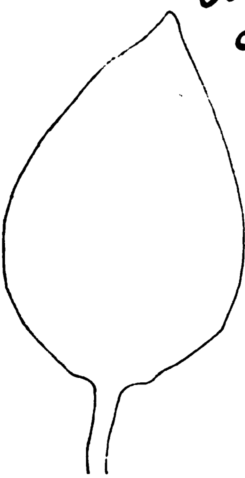


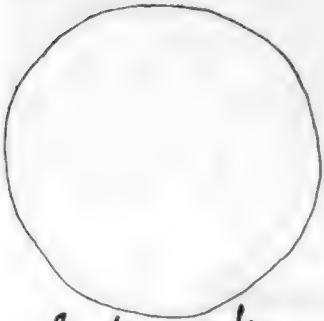
Alex. Allen





Allen's L.S.





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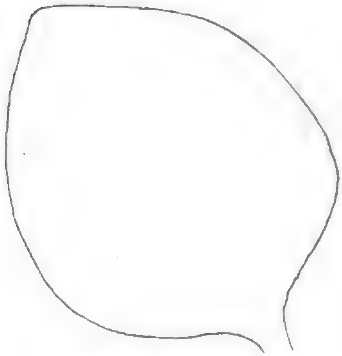

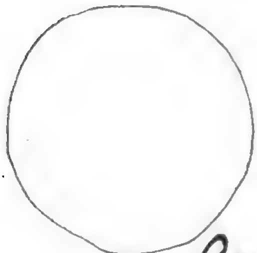

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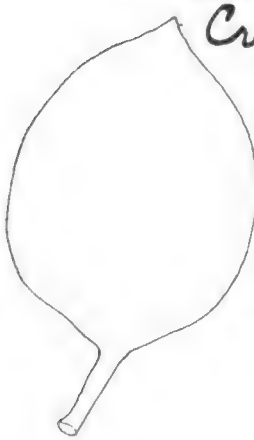

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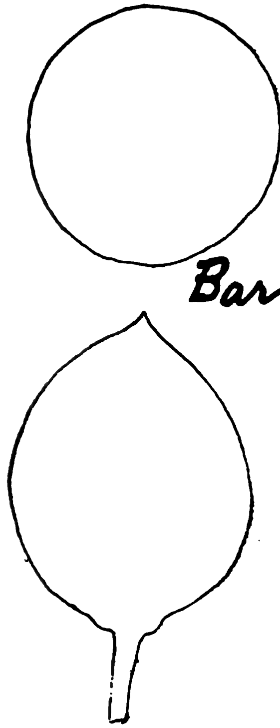

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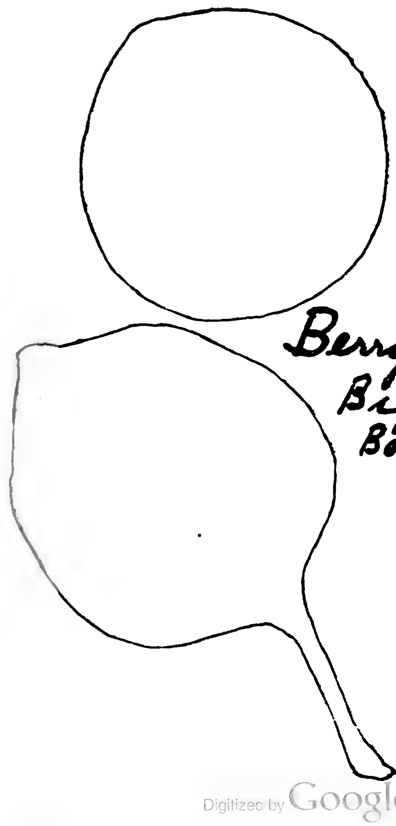
Barnet



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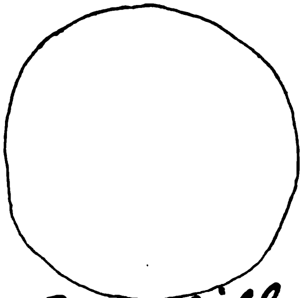

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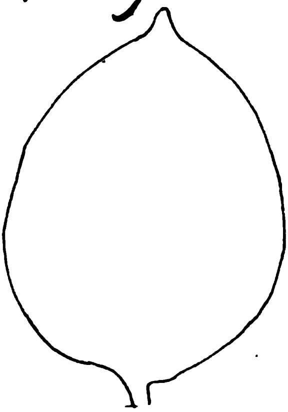

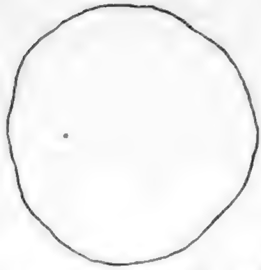

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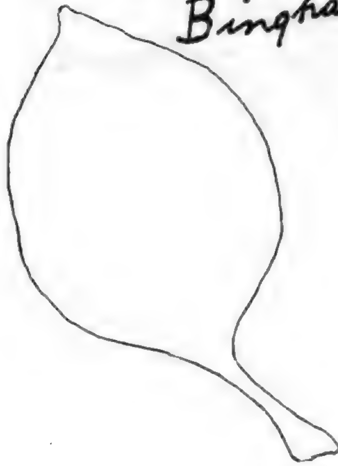

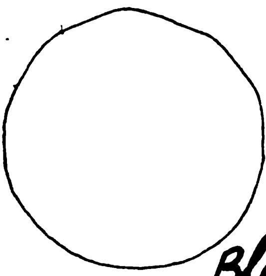

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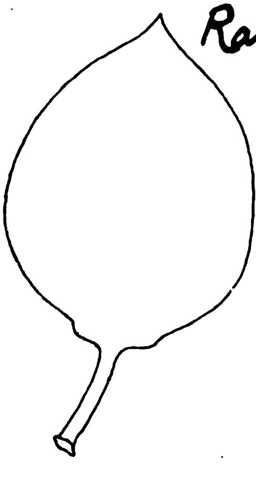

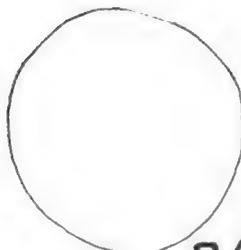

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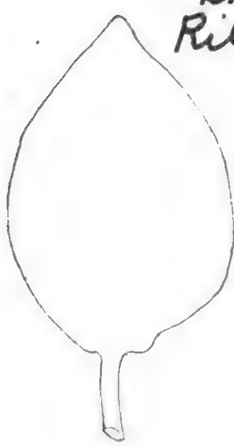

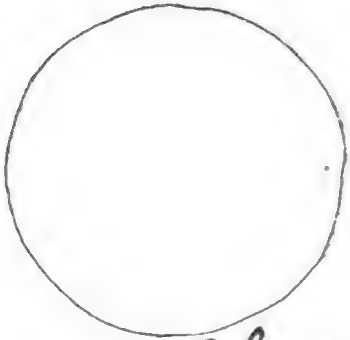

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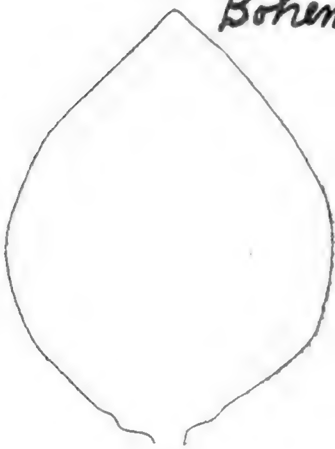

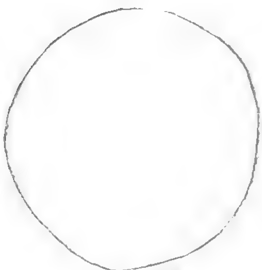

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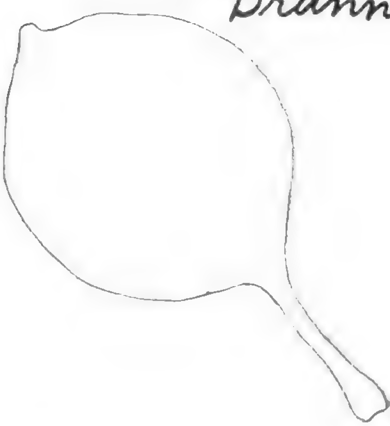

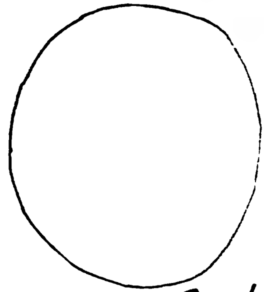

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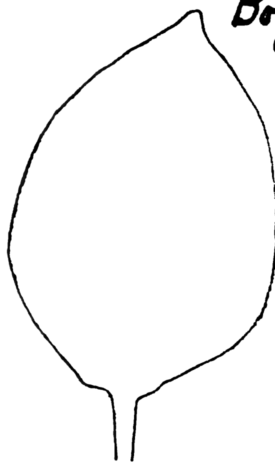

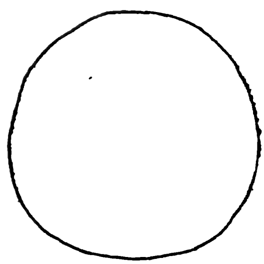

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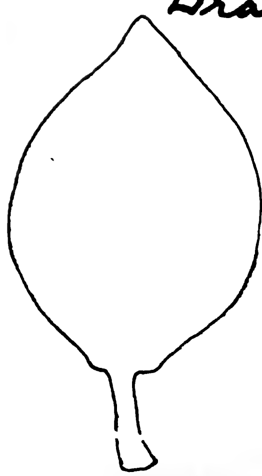

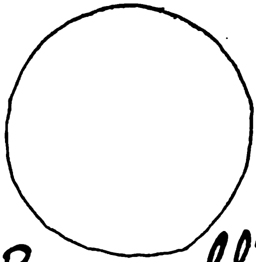

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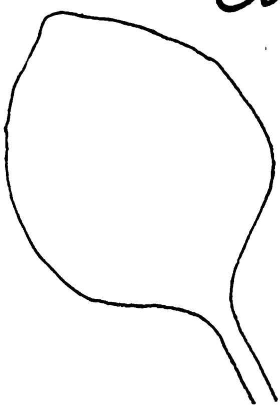

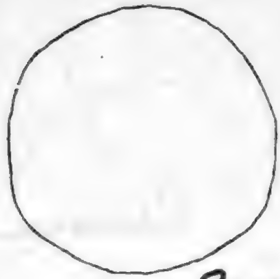

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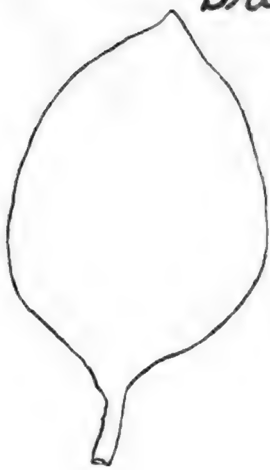
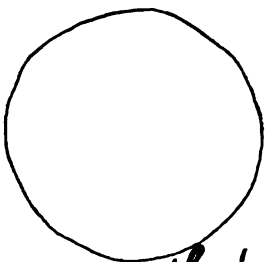
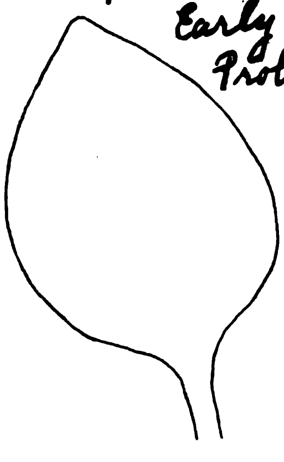
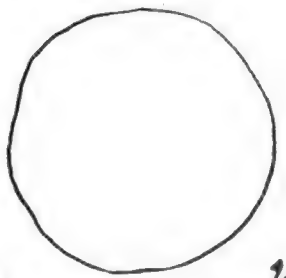




Butler's Early Prolific





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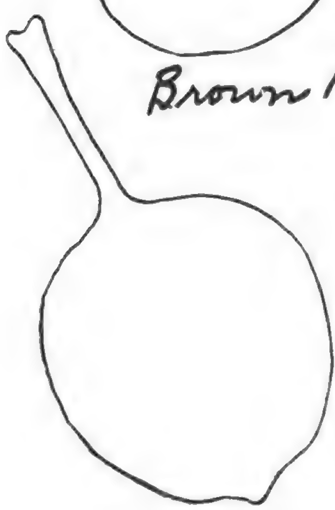

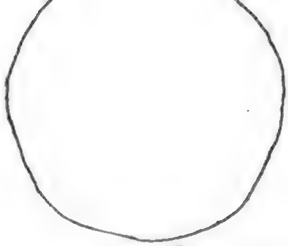

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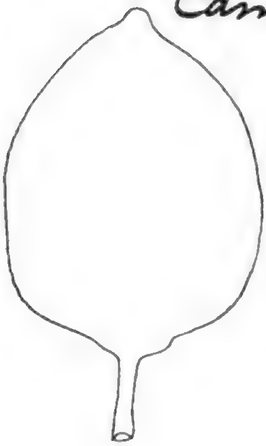

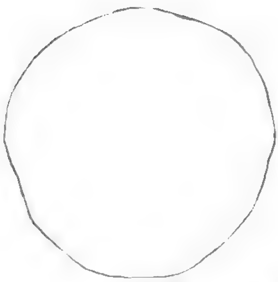

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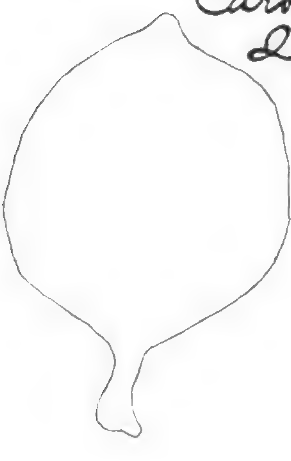

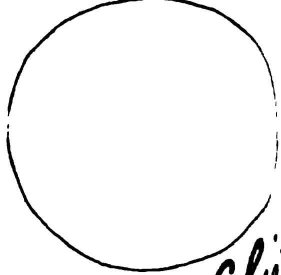

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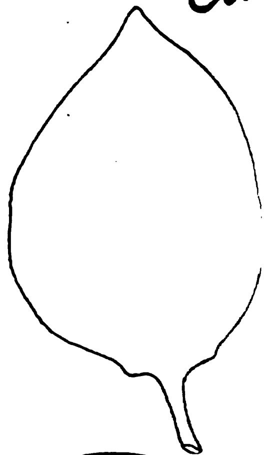

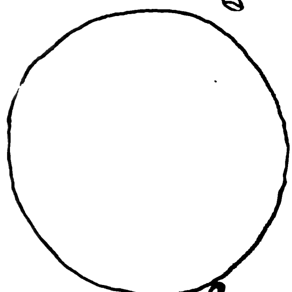

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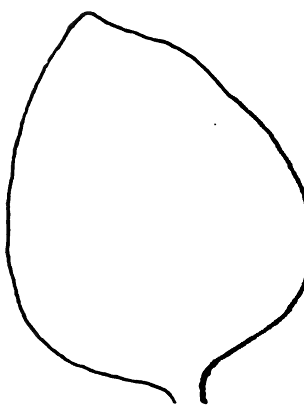
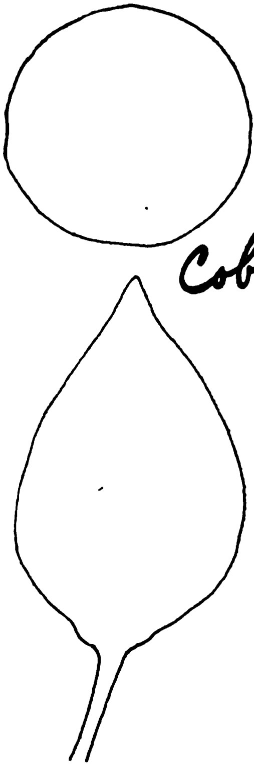
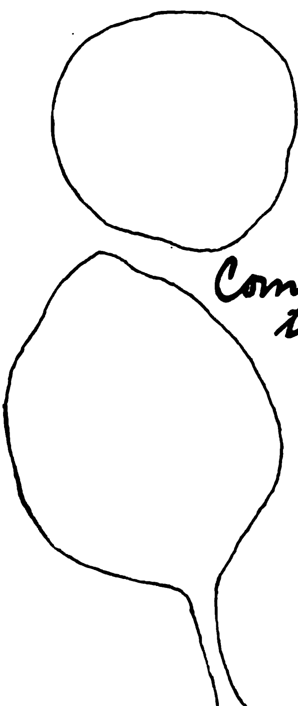




Cobweb

Cook's Impd.



Combination

Christopher

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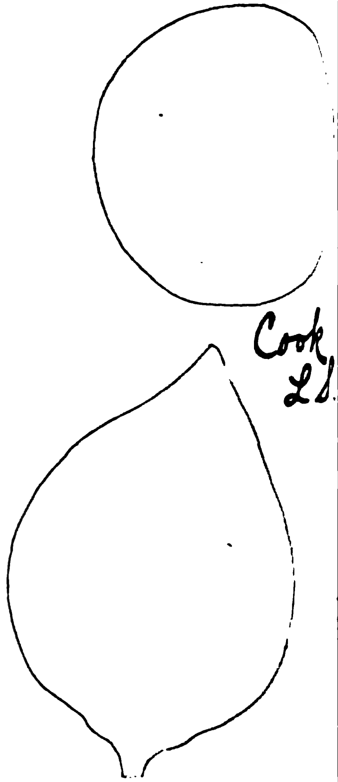
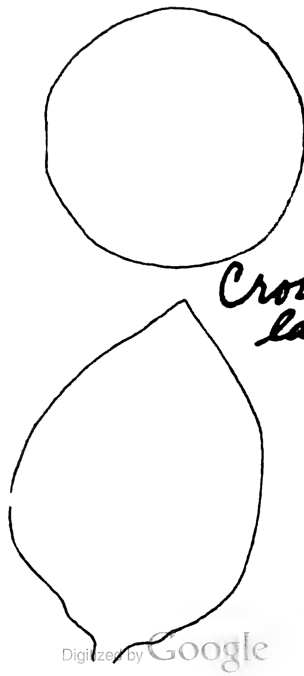


Cook L.S.

Cummings



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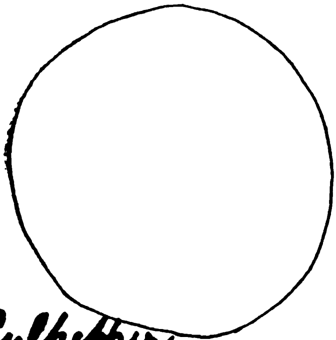

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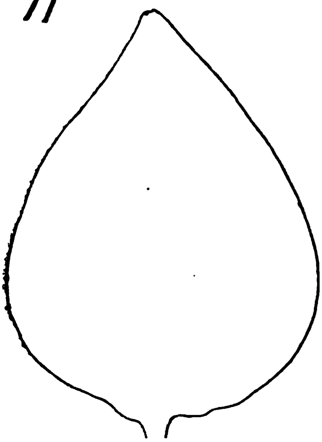

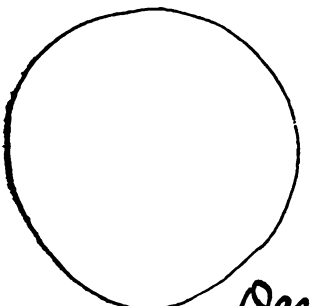

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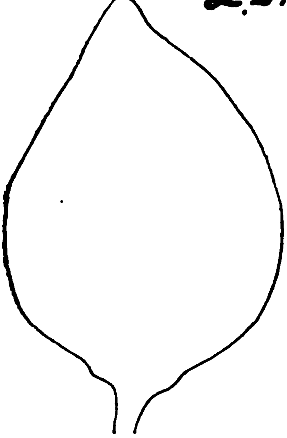
L.S.



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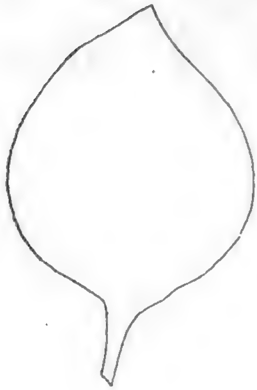

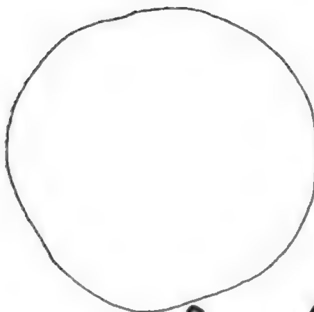

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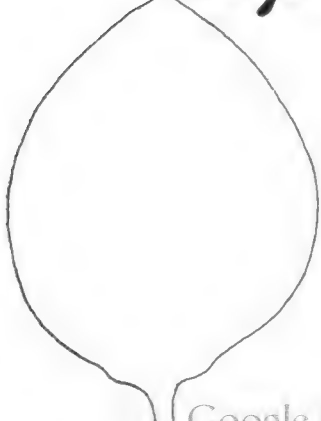
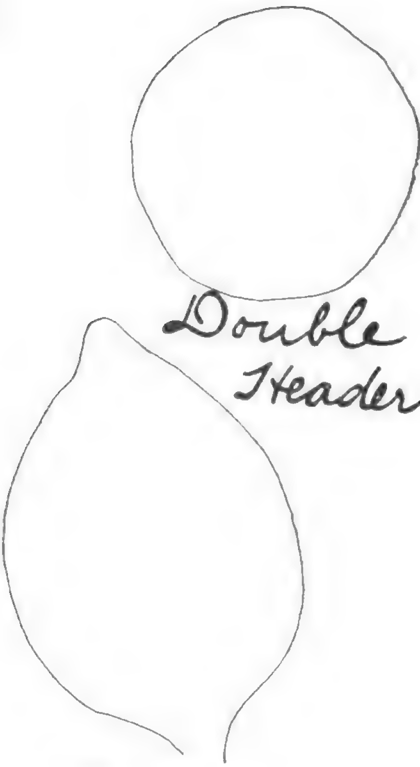


Diamond

Doughty L.S



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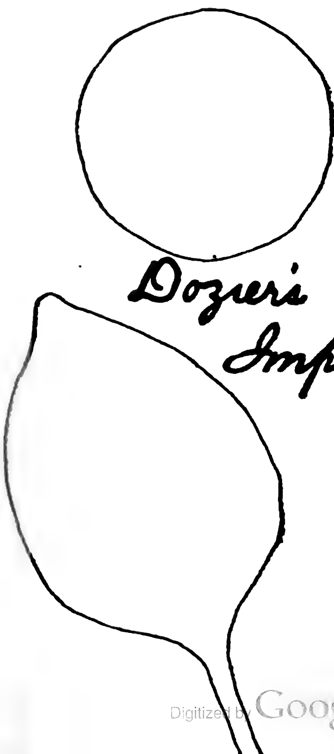
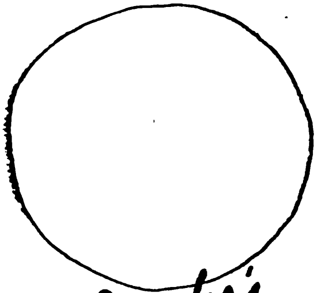
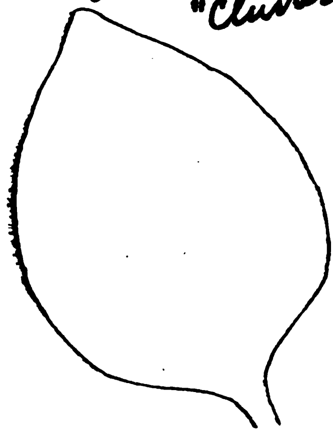
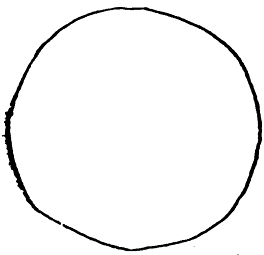


Dozier's Impd.



Drake's "Cluster".





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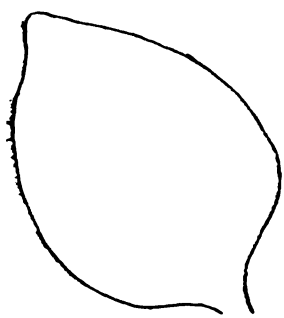

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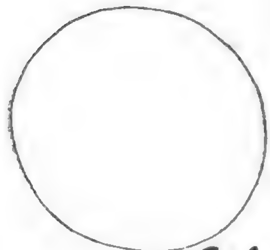

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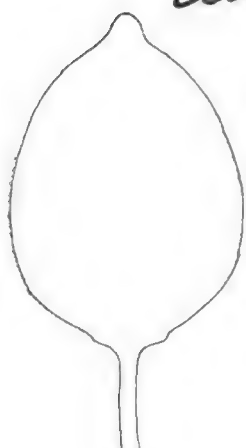

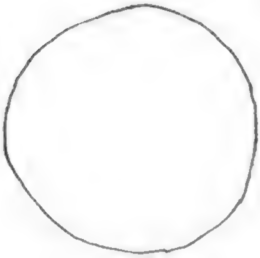

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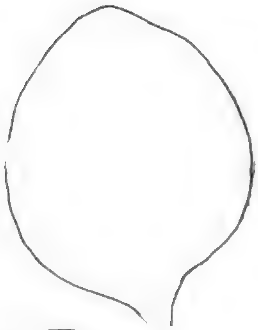

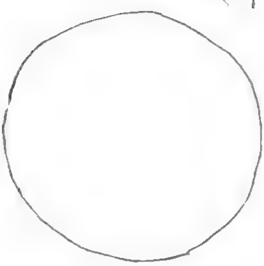

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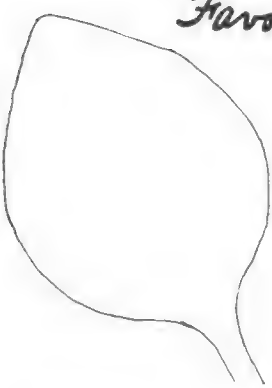

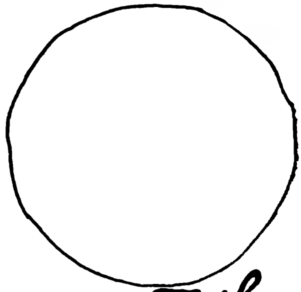

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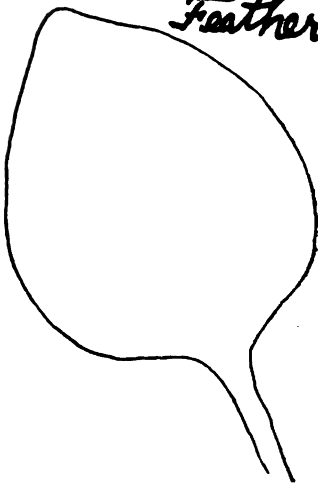

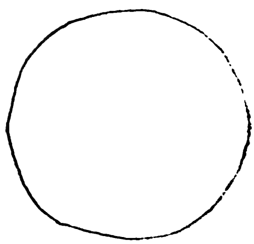

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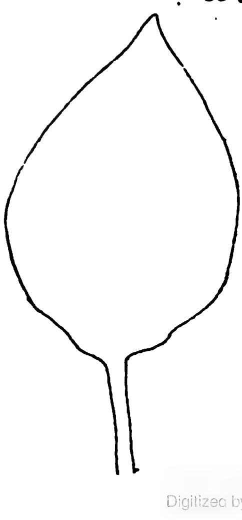

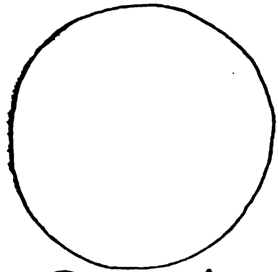

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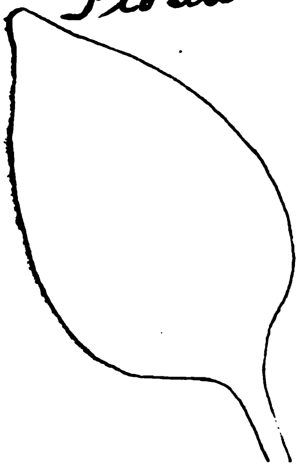

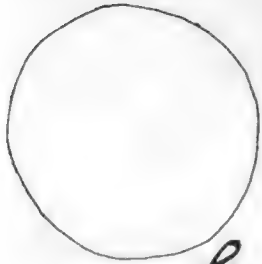

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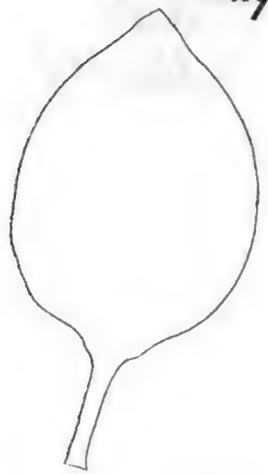

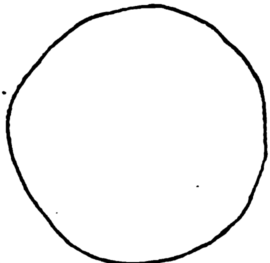

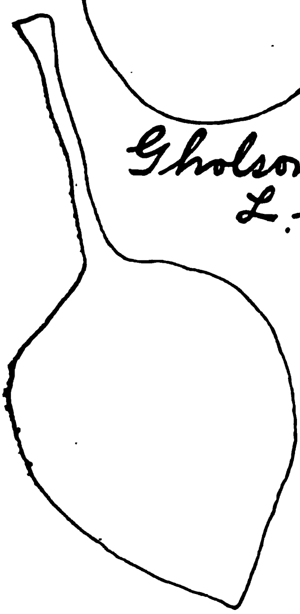

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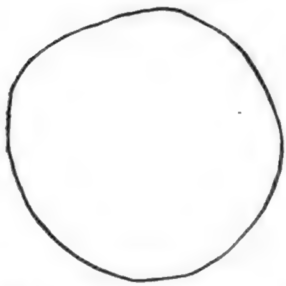

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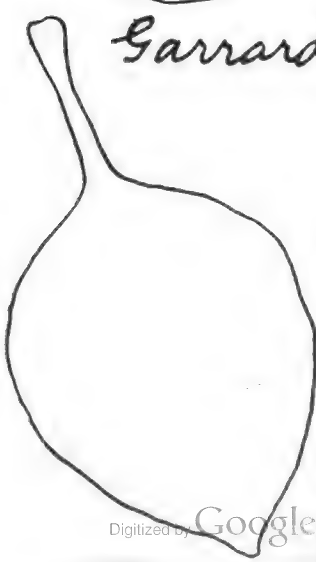

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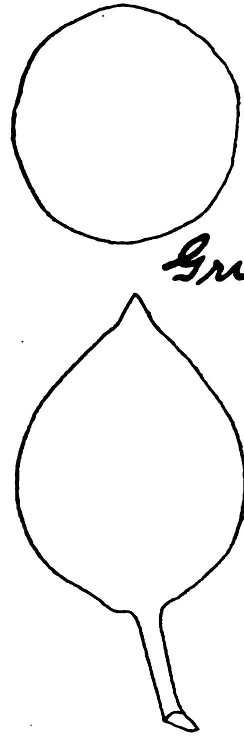

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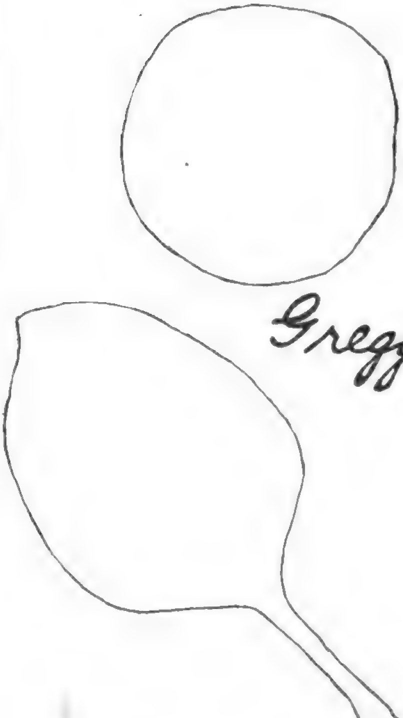

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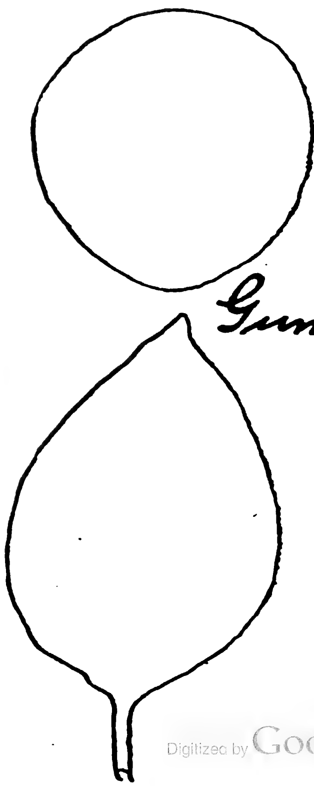

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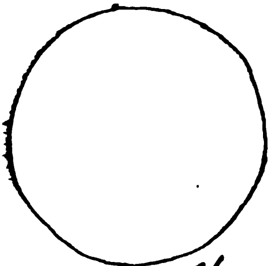

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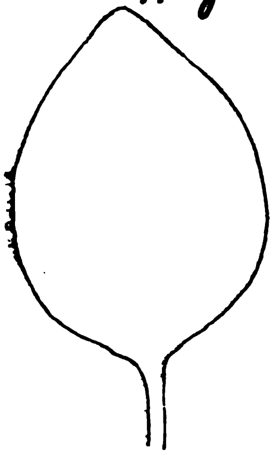

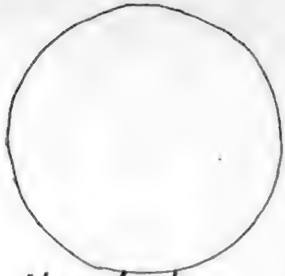

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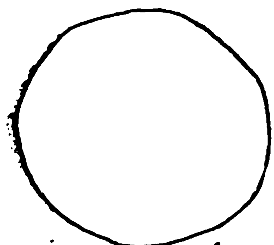

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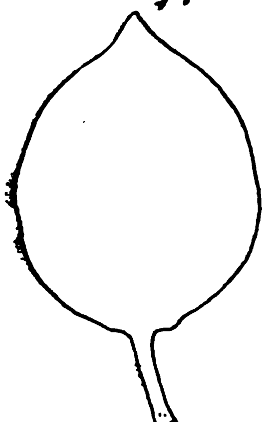

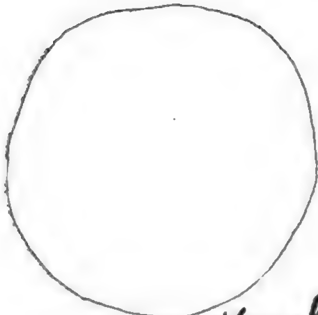

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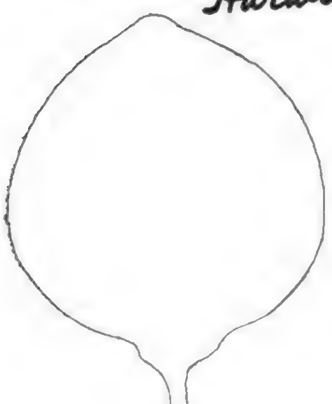

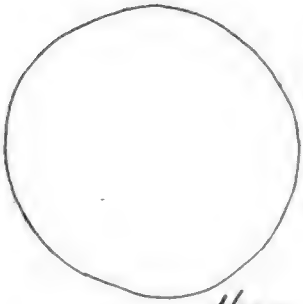

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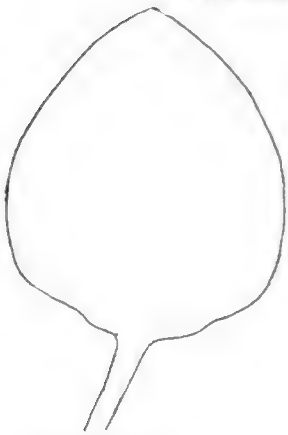

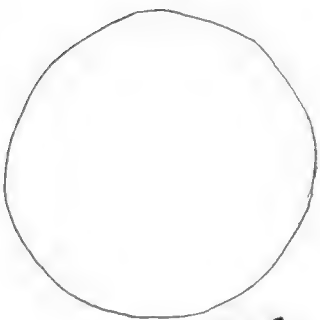

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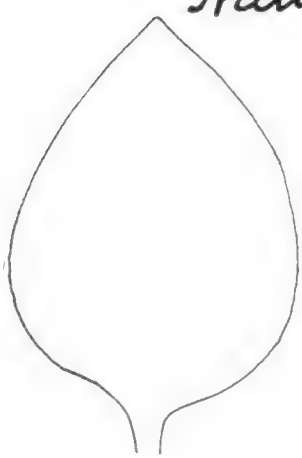

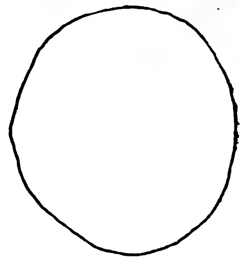

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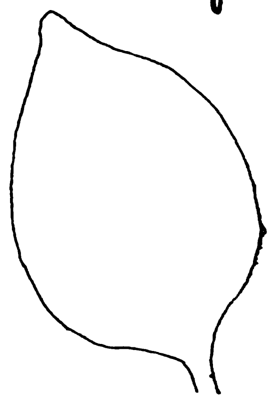

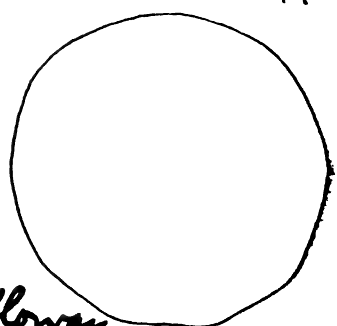

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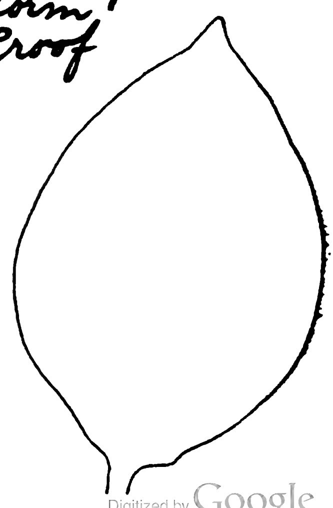
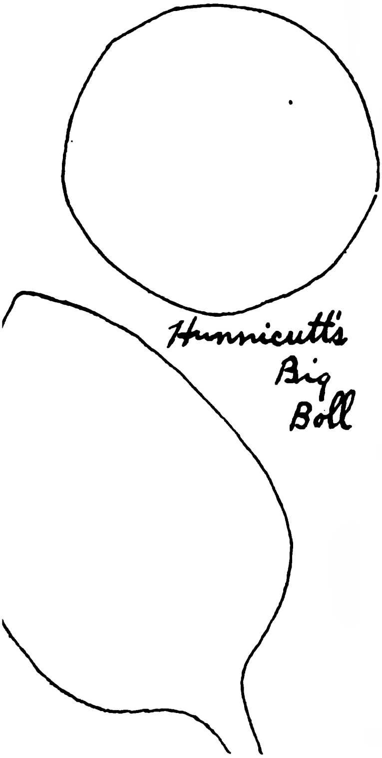
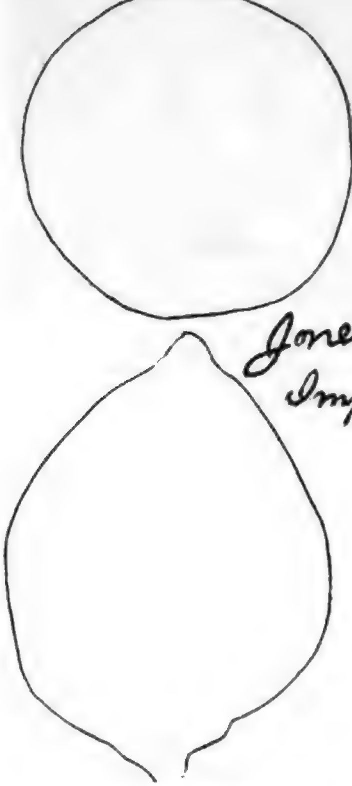




Hunnicutt's Big Boll



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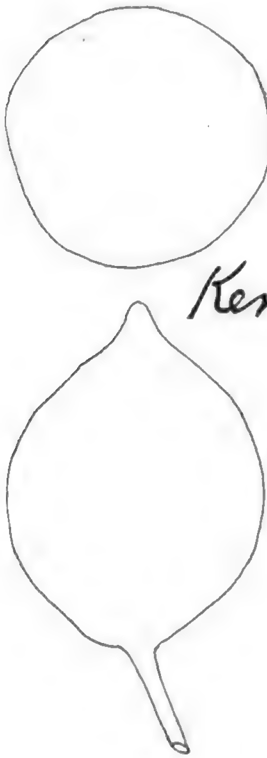

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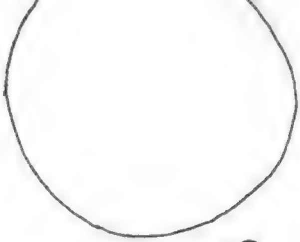

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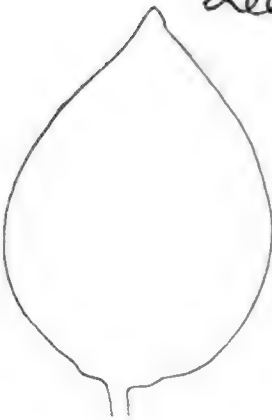

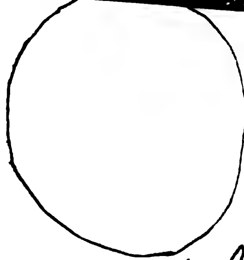

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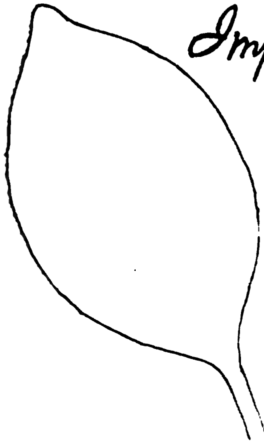

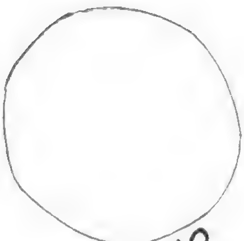

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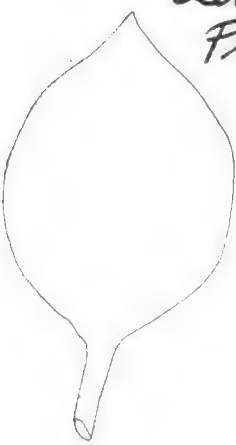

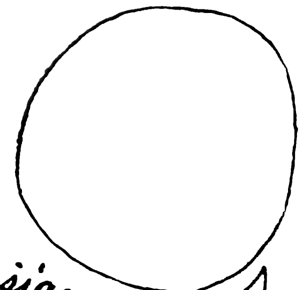

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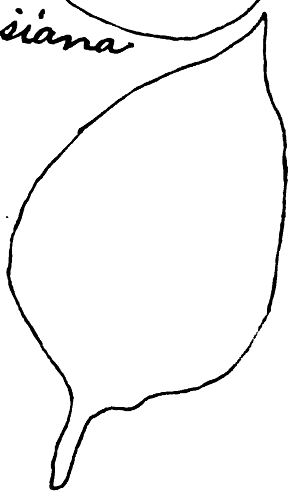

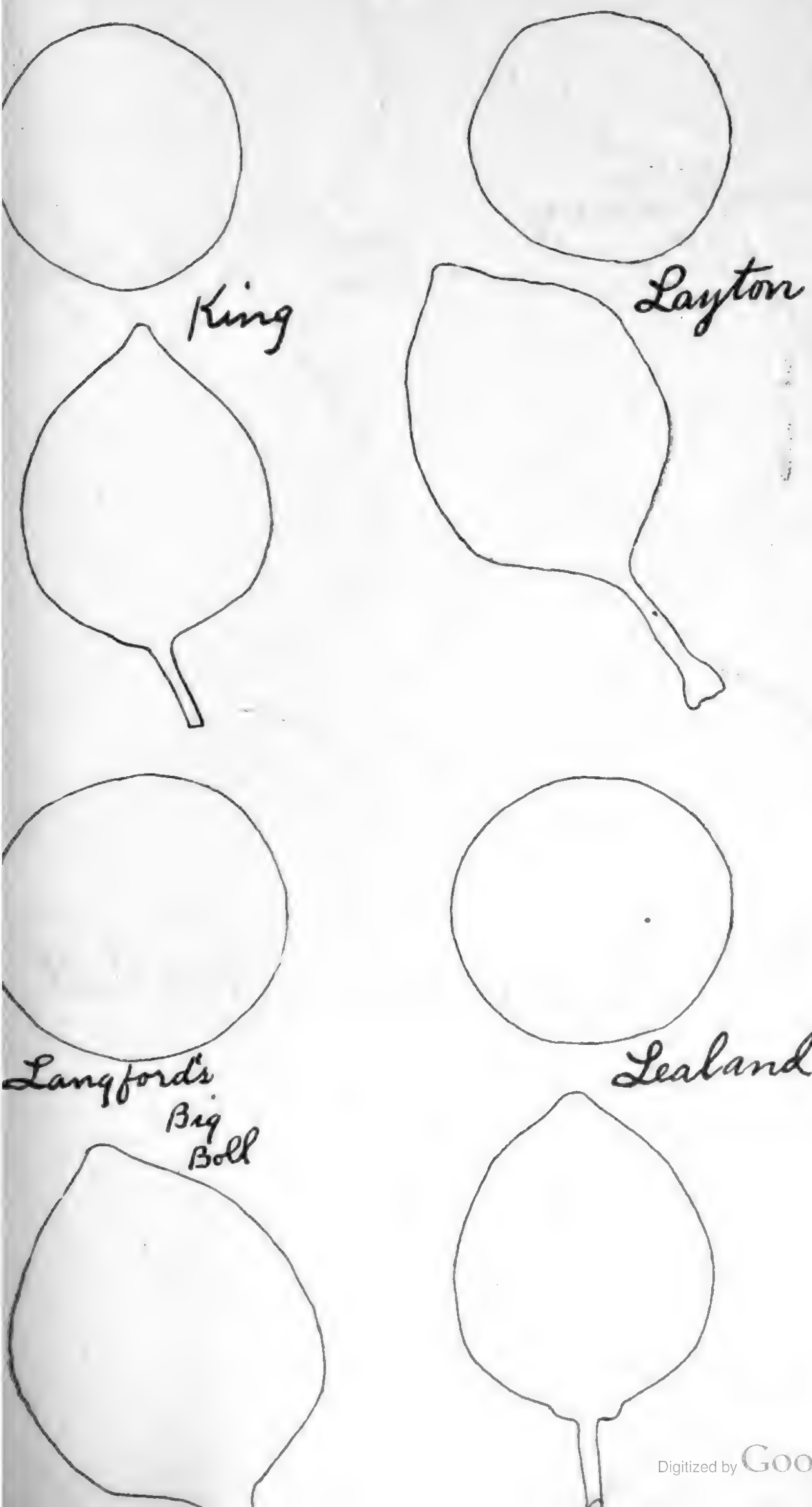
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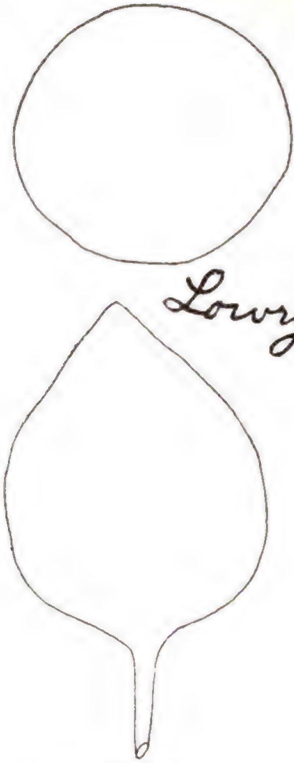
Layton
Langford's Big Boll
Lealand



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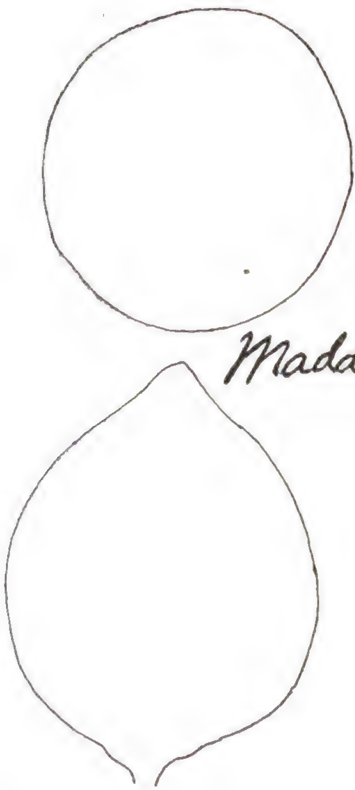

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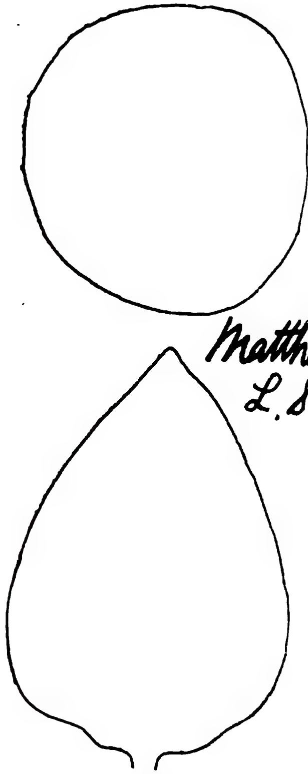

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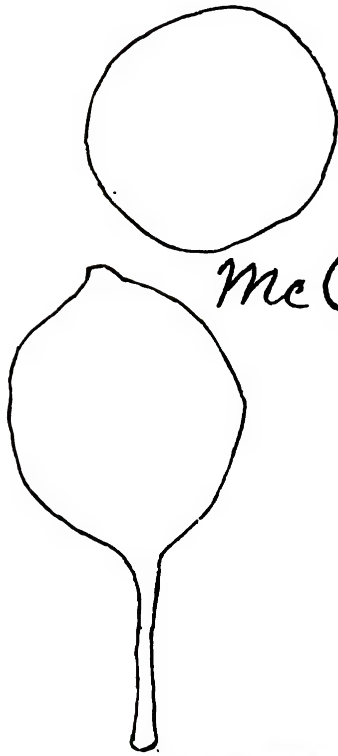

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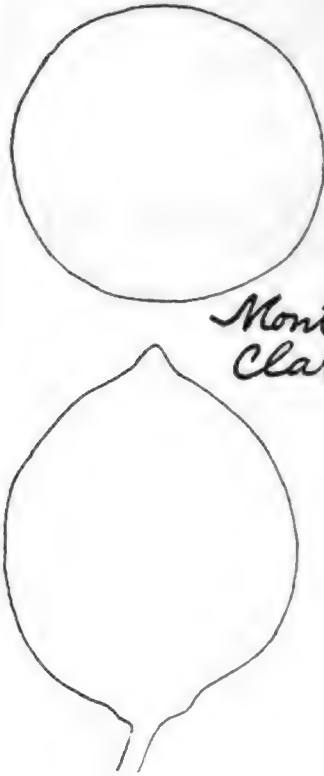

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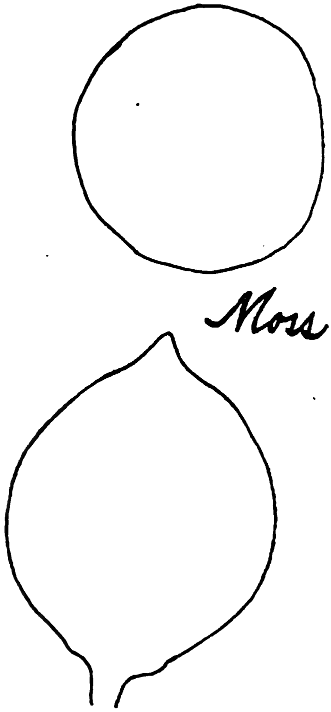

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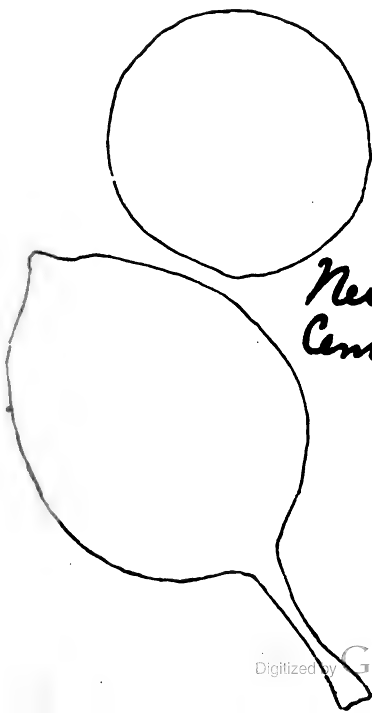
Mortgage Lifter



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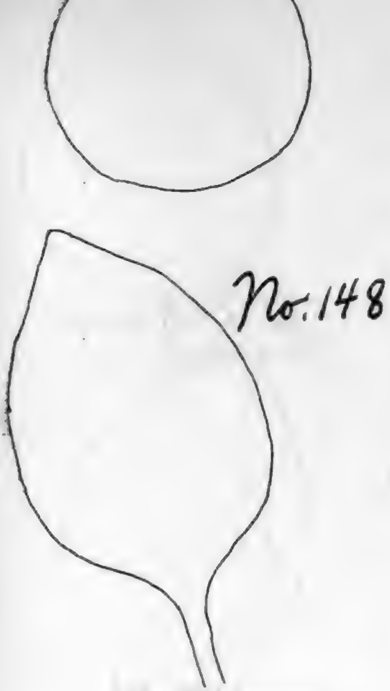

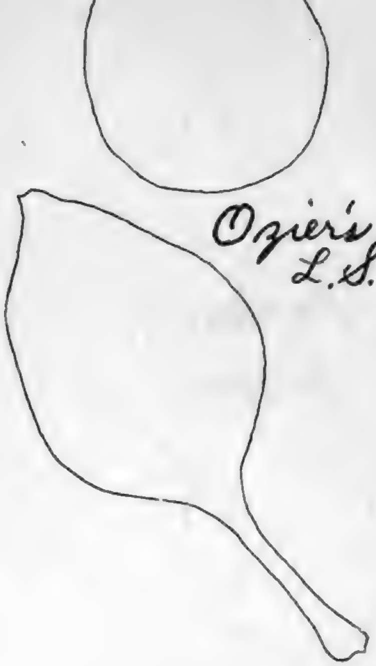

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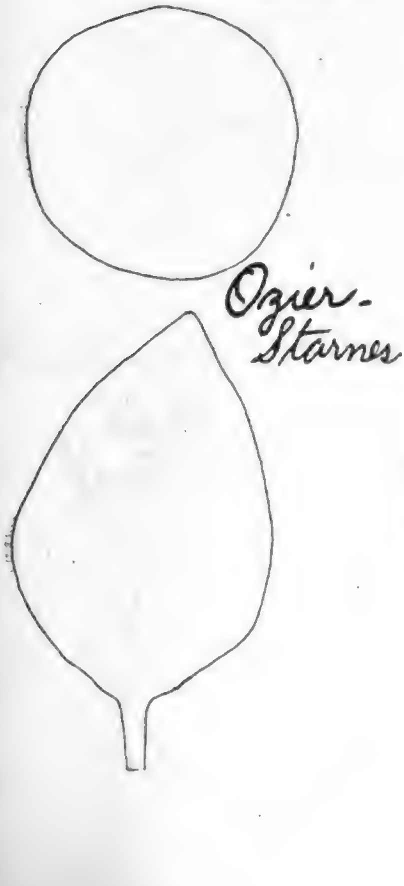

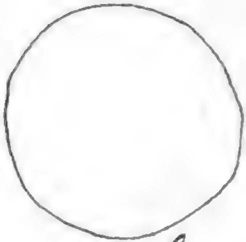

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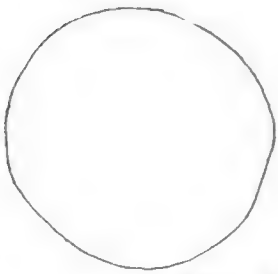

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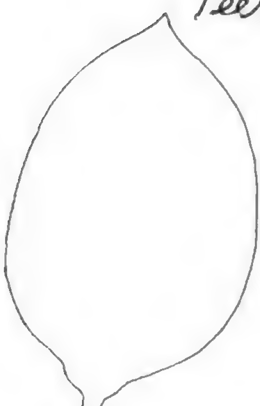

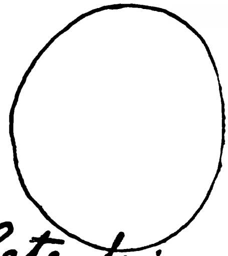

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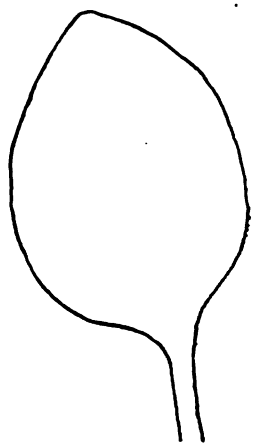

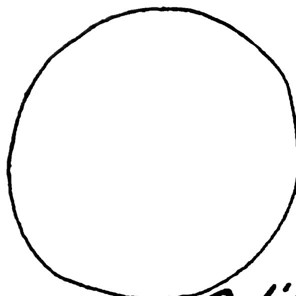

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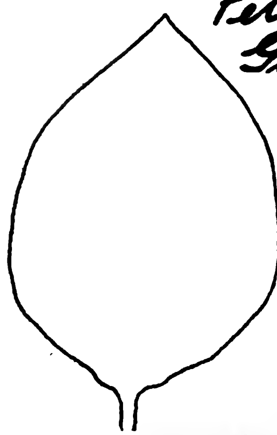

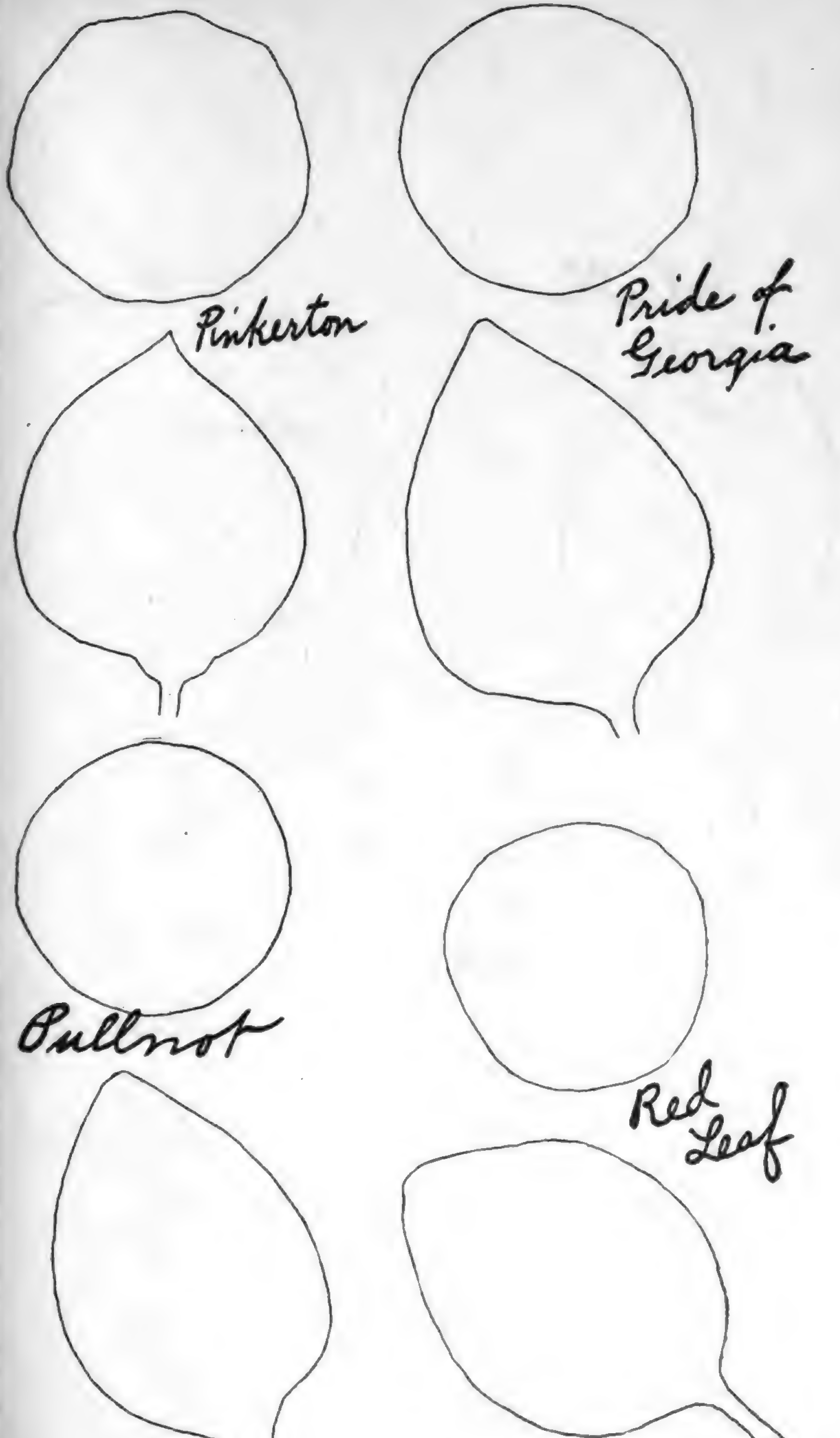
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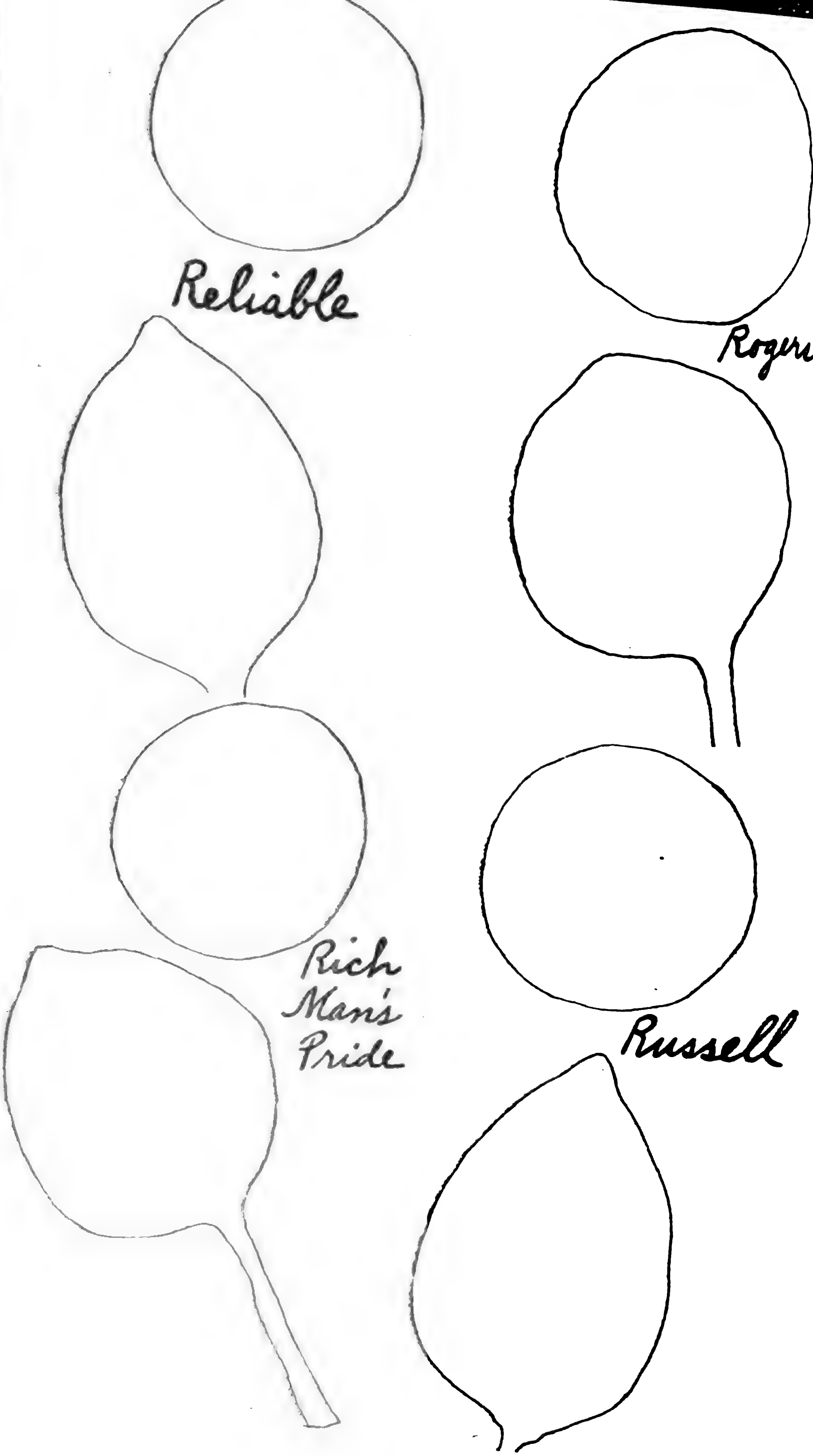
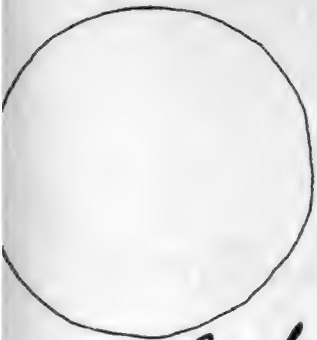
Pride of Georgia
Bullnot
Red Leaf


Reliable
Rogers
Rich Man's Pride
Russell



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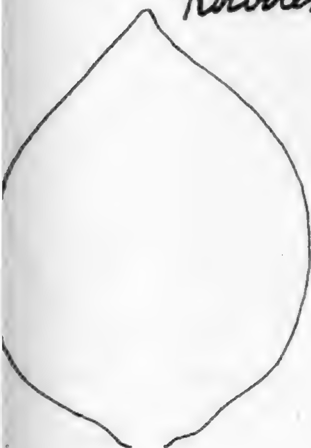
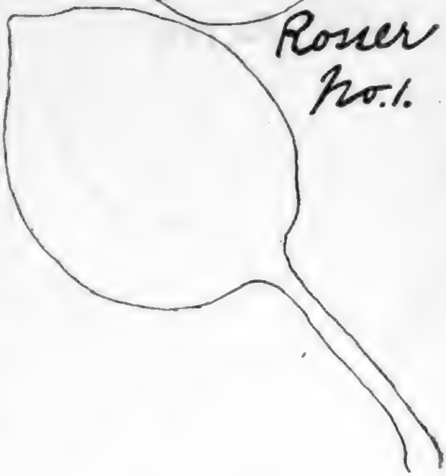
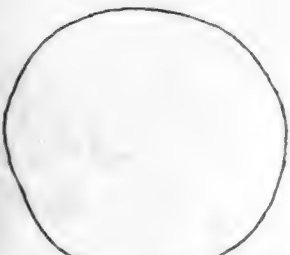


Rosser No. 1.





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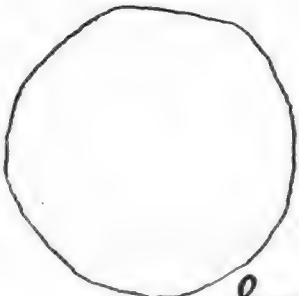
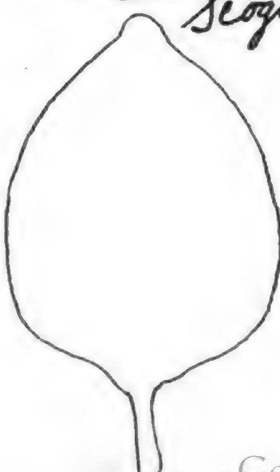
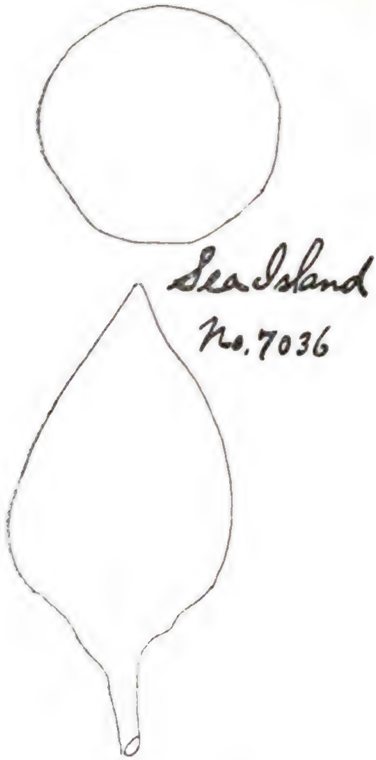
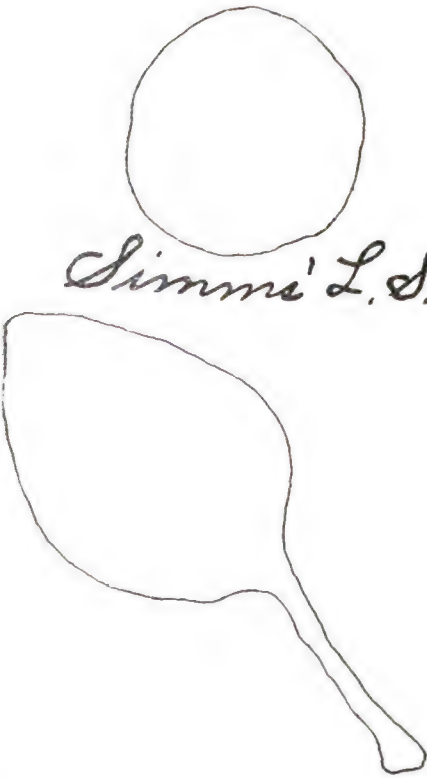


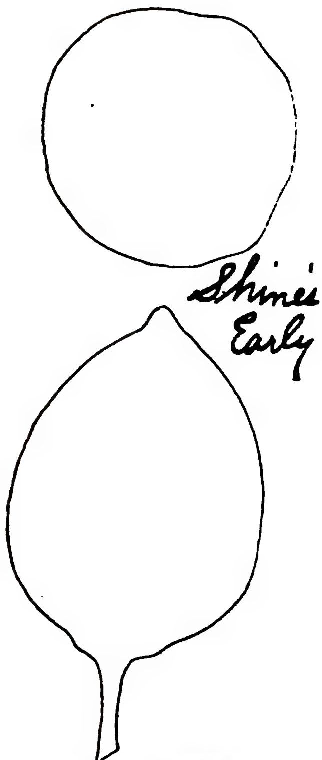
Scogin

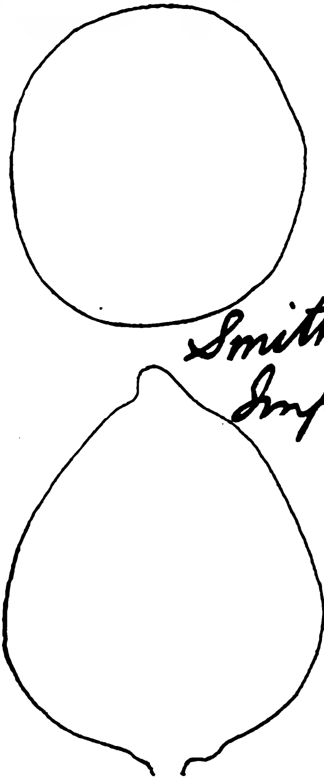



Sea Island
No. 7036

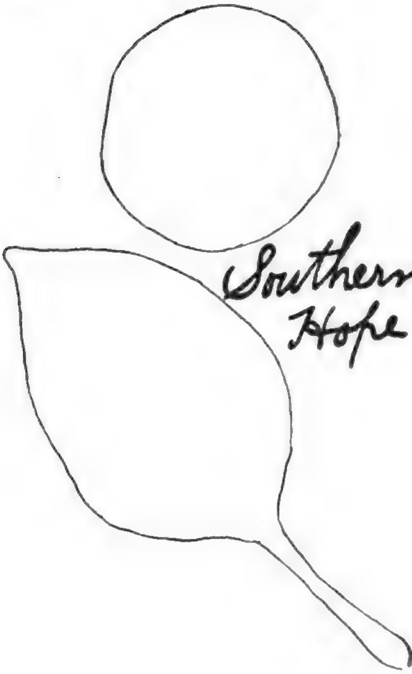

Sistrunk


Simms' L. S.

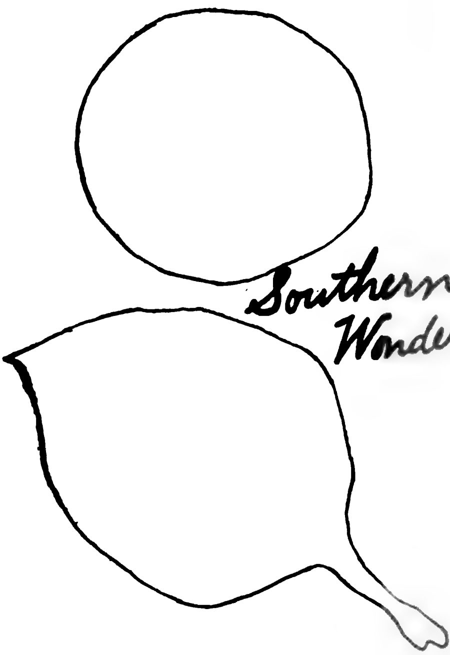

Shine's
Early



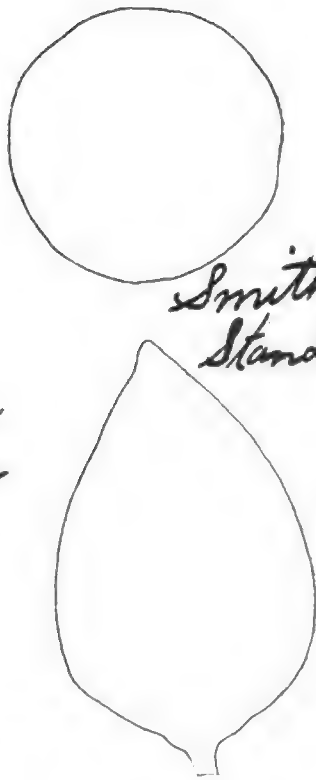
Smith's Impd.



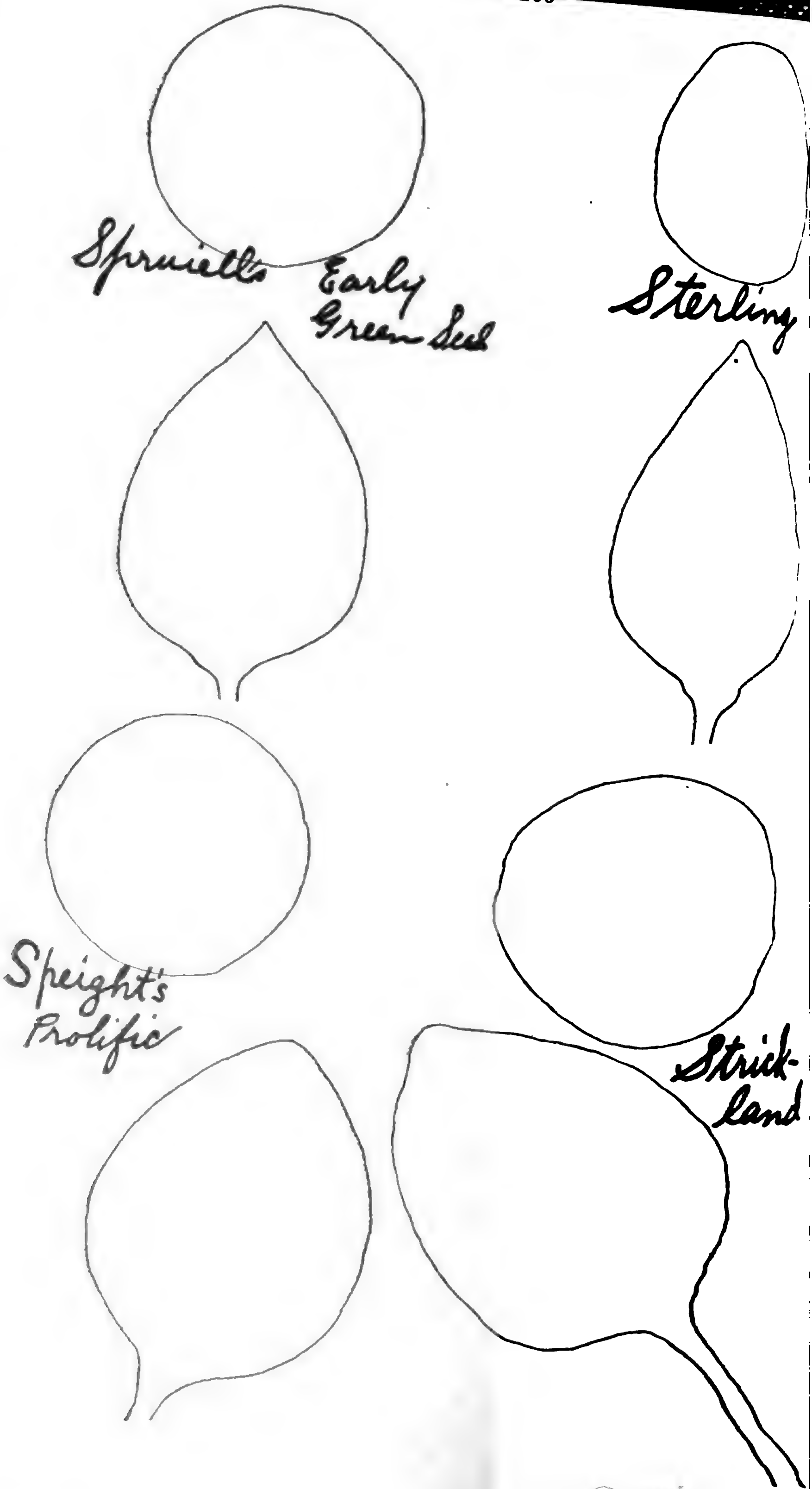
Southern Hope

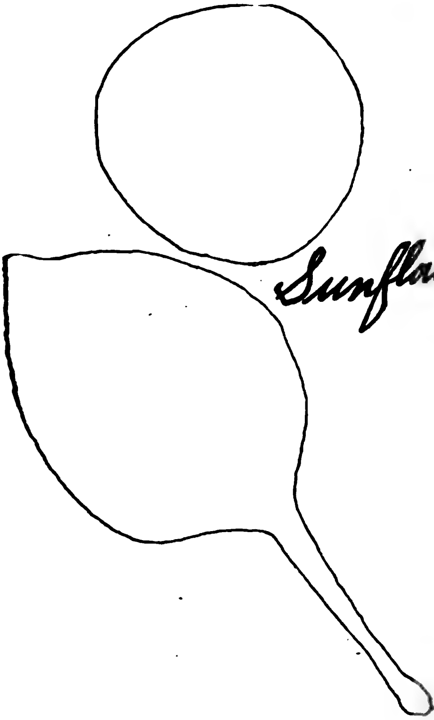


Southern Wonder

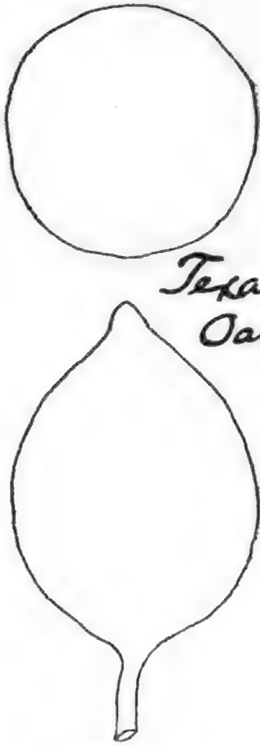


Smith's Standard


Spruiell's Early Green Seed
Sterling
Speight's Prolific
Strick-land

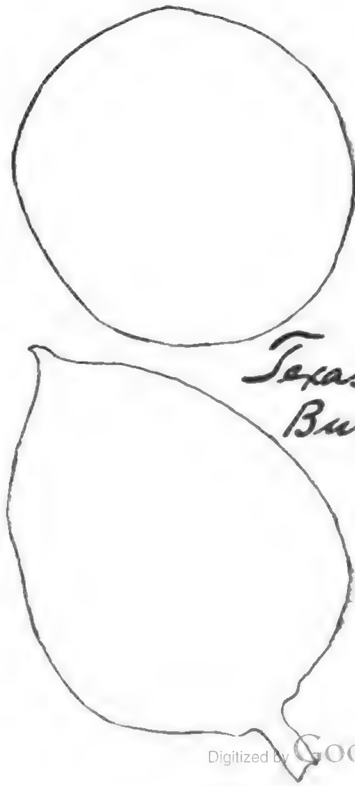


Sunflower

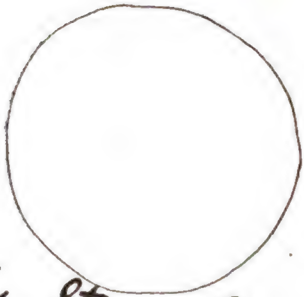


Texas Oak

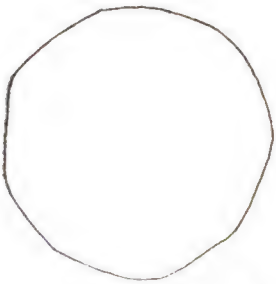
Tatum's Big Boll



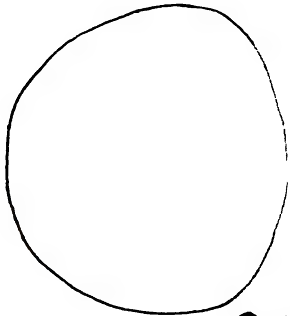
Texas Bur



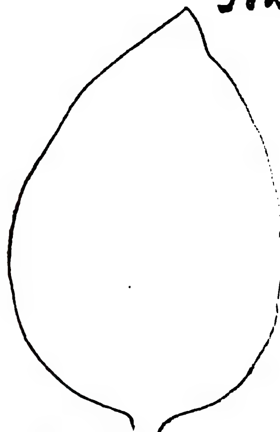
Tex. Storm Proof

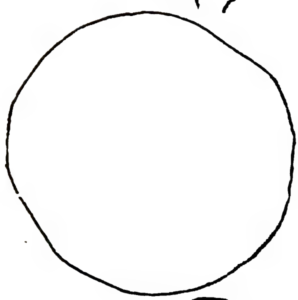


Toole

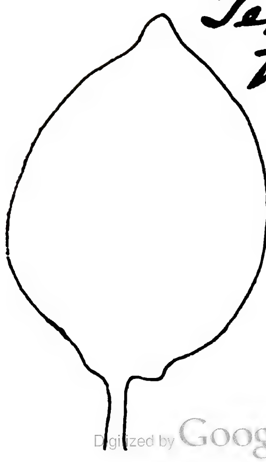


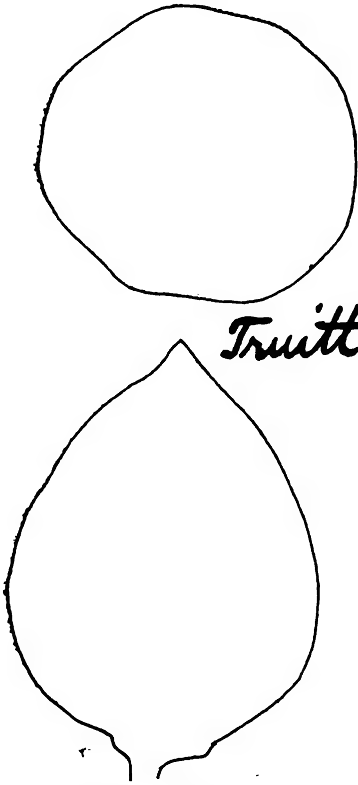
Todd



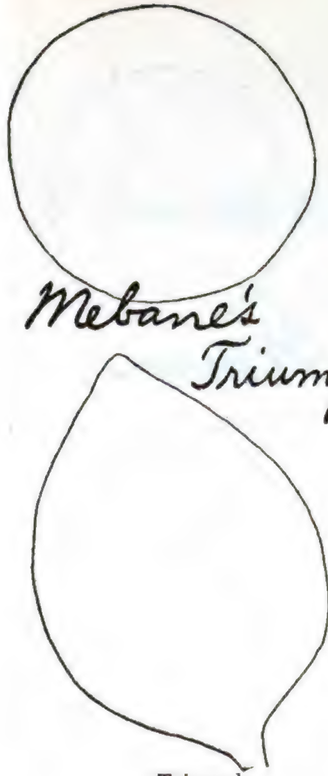


Texas Wood



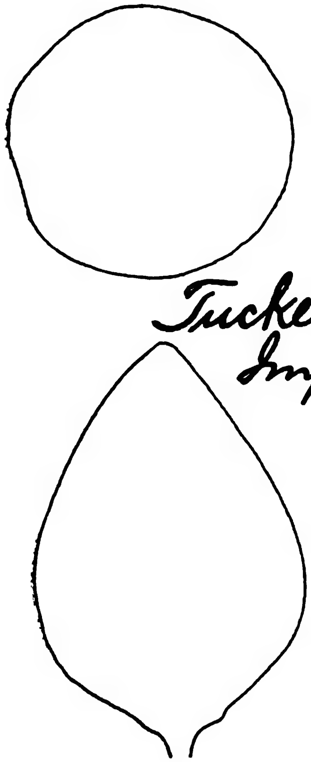


Truitt



Mebane's Triumph

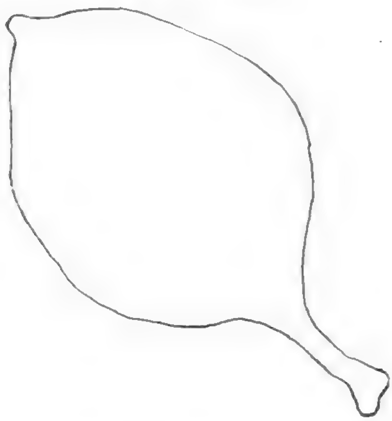
Triumph.

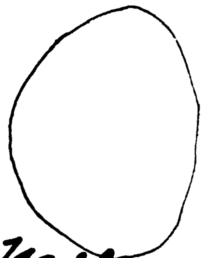


Tucker's Impd.

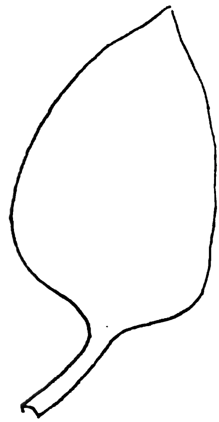
Victor

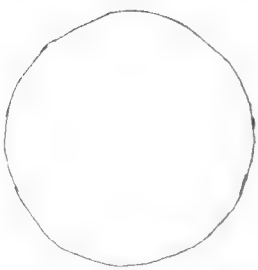
Warren



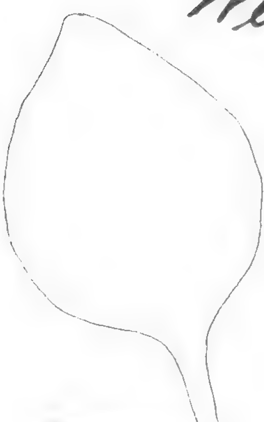


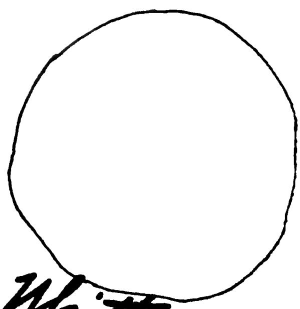
Welborn



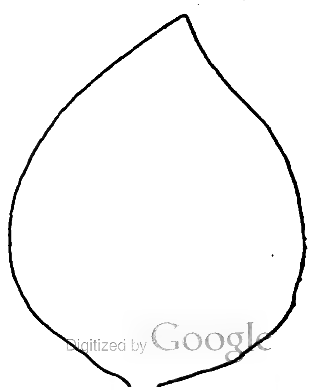


Webb





Whitten



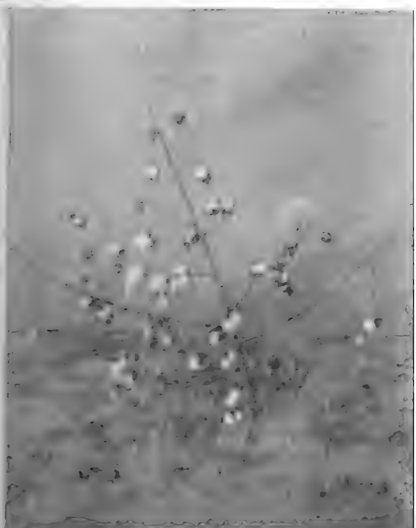

Wise
Wilson's Matchless
Woodfin's Nonpareil
Wyche's Big Boll

PLATE I.

Alex. Allen.

Anderson.

Bingham.



Black Rattler.

PLATE III.

Blue Ribbon.

Boyd.

Breeden.

Brown No. 1.

PLATE V.

Butler.

Cameron.

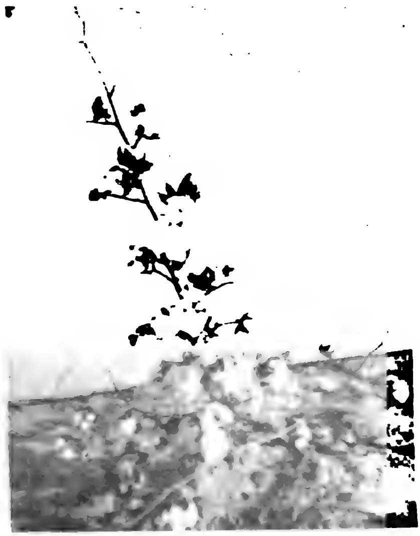
Combination.

Cook Improved.

PLATE VII.

Cook Long Staple.

Crossland.



Dickson.

Dixie.

PLATE IX.

Dongola.

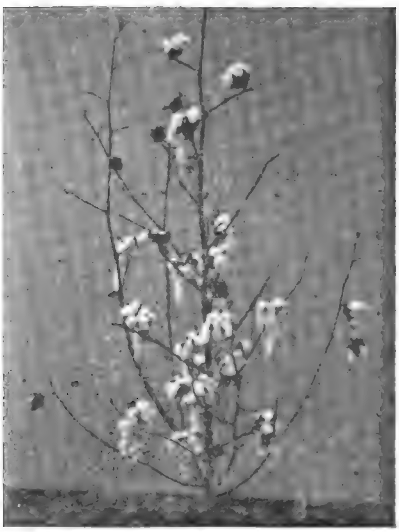
Double Header.

Edgeworth.

Eureka.

PLATE XI.

Excelsior.

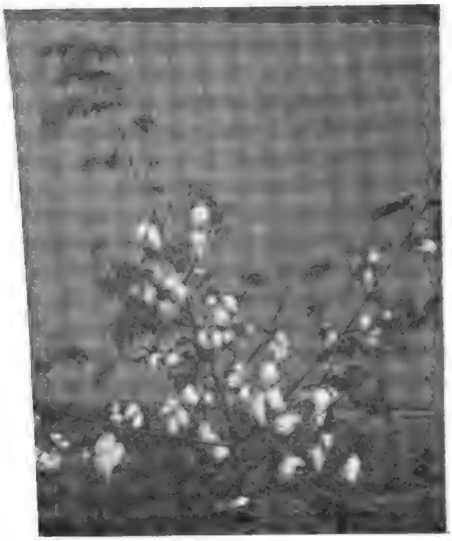


Extra Early.

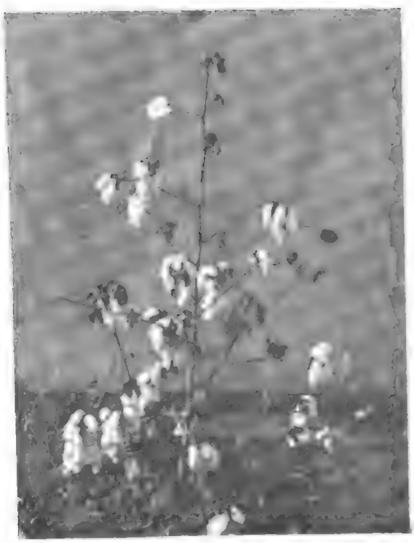
Garrard.

Gayosa Prize.

PLATE XIII.



Gholson Long Staple.

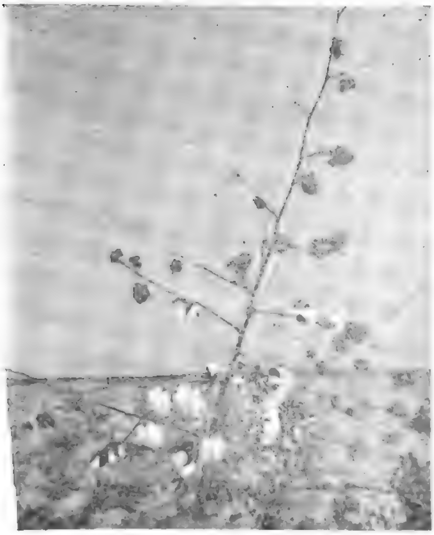


Gold Standard.

Harden.

Haralson.

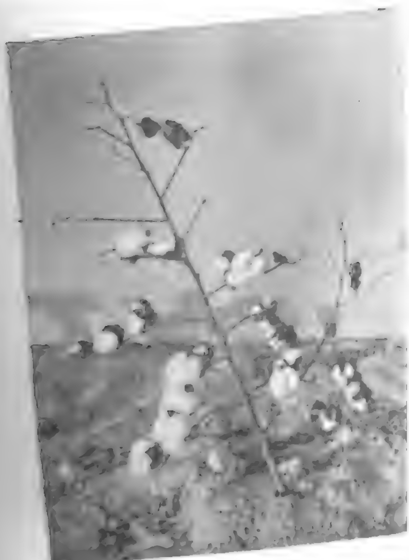
PLATE XV.



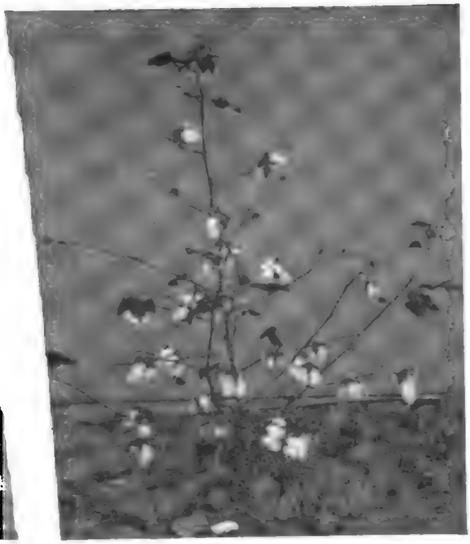
Herndon.

Hodge.

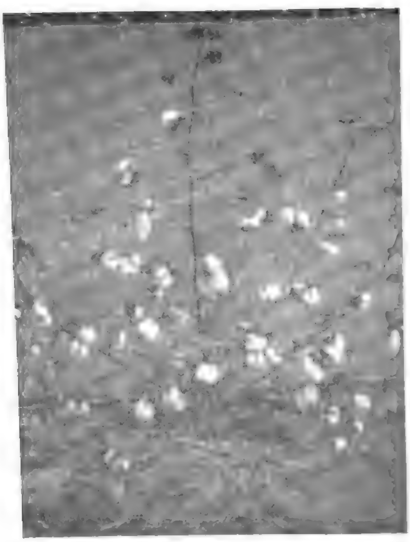
Keno.



King.



King No. 2.



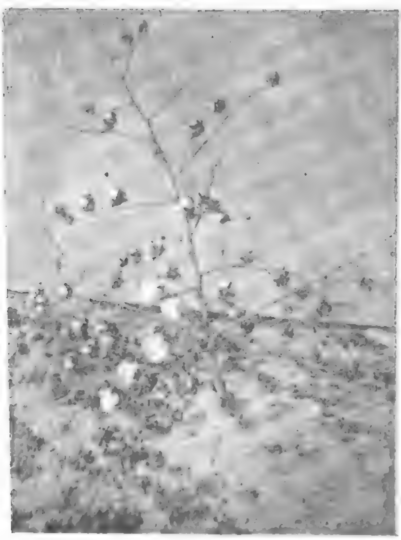
King No. 3.

Lewis Prize.

Louisiana.

PLATE XIX.

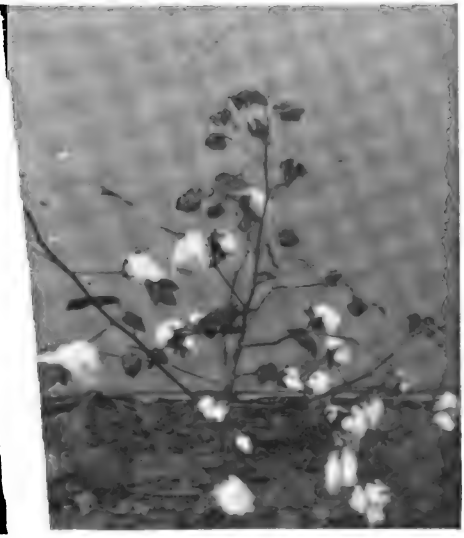
Maddox.



Mattis.

Missionary.

Mitchell.



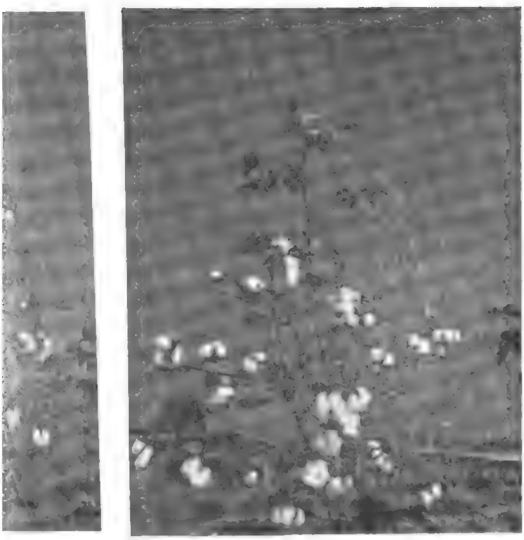
Mortgage Lifter.

Montclare.

Ozier Starnes.

Parker.

Peerless.



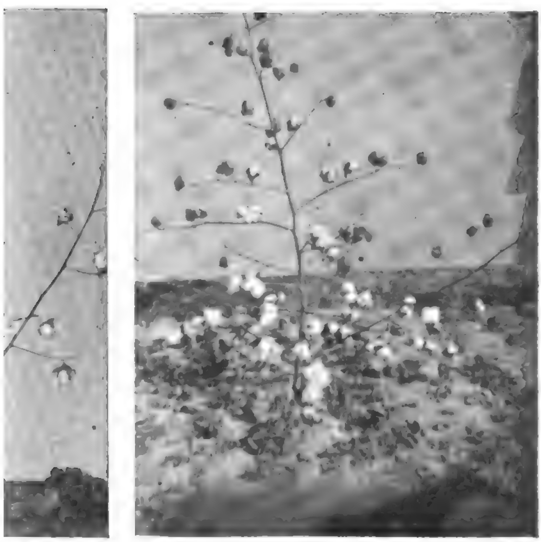
Peterkin.

Red Leaf.

Reliable.

PLATE XXV.

Rich Man's Pride.



Roby.


Ruralist.

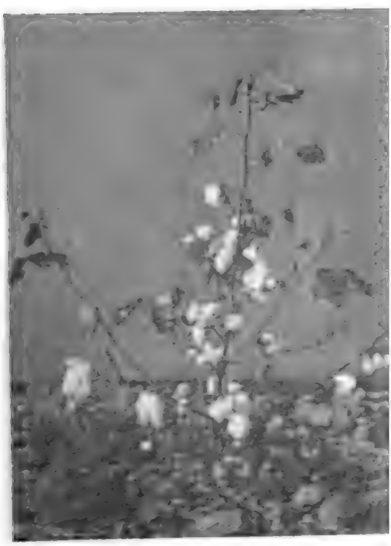
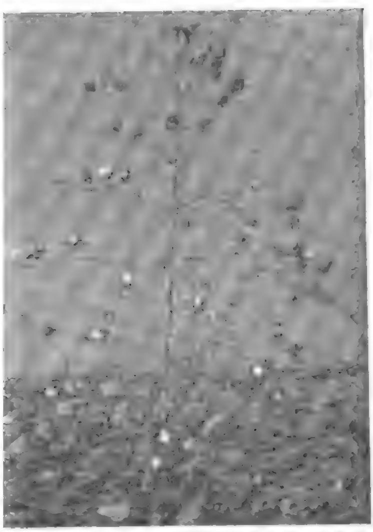

Schley.

PLATE XXVII.

Scogin.



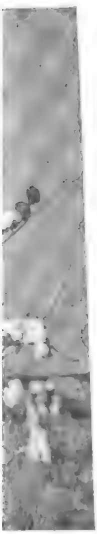
Sea Island.

Shine No. 2.

Smith Improved.

PLATE XXIX.

Smith Standard.



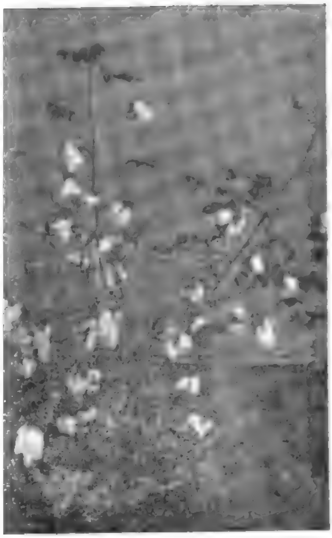
d.

Southern Wonder.

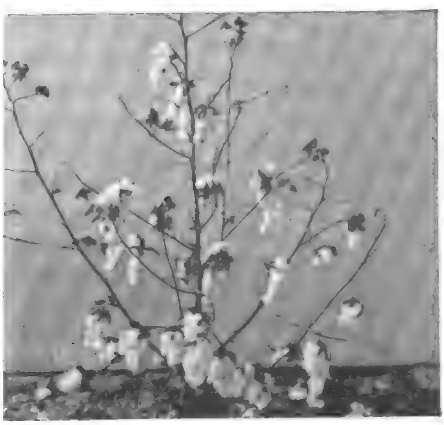
Sterling.

Strickland.

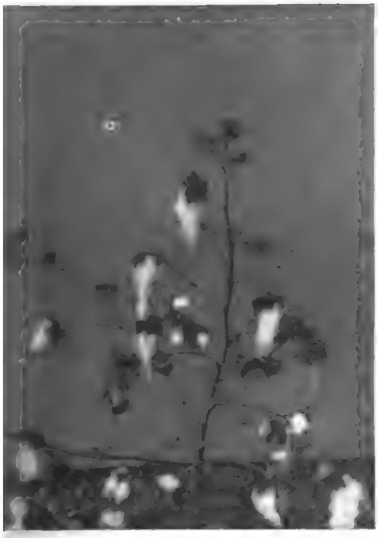
PLATE XXXI.



Sunflower.



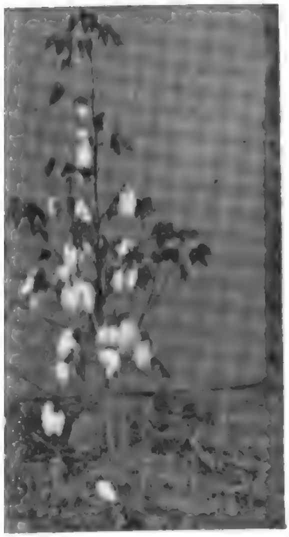
Tatum.



Todd.

Toole.

PLATE XXXIII.



Triumph.

Truitt.

Welborn.

Whitten.

PLATE XXXV.

Wilson.

Wise.

BULLETIN NO. 141

A L

Agricultural

Alabama P

AU

Texas o

C.

OPE

THE POST

JULY, 1907

BAMA

xperiment Station

: THE

ytechnic Institute

BURN-

Tick Fever

BY

A. CARY

'ELIKA, ALA.
ST PUBLISHING CO.
1907

TICK OR

C.

HISTORY

Tick or Texas fever h
in parts of Europe, Asia
America by the Spania
Indies, South America a
States it came by way c
close of the eighteenth
County, Pennsylvania, i
tle from North Carolina
sive and serious outbr
in Texas and in the st
Texas cattle were trail
it the name Texas feve
cause Texas is in no wa
tick is the only real ca
fever.

In 1889 Theobald Sr
Industry, discovered t
the blood of cattle sick
and 1890 Kilborne fou
was the carrier of th
the healthy cattle. I
Missouri, and Franci
blood inoculation exp
successful. Dalrympl
sippi, Butler of North
Willoughby of Georgi
Alabama, successfull
produce relative imm
or susceptible cattle.
attempts were made
in cattle by inoculati

TICK OR TEXAS FEVER.

BY

C. A. CARY.

HISTORY OF TICK FEVER.

Tick or Texas fever has existed in cattle for centuries in parts of Europe, Asia and Africa. It was brought to America by the Spaniard, who infested first the West Indies, South America and next Mexico. Into the United States it came by way of Florida and Mexico. Near the close of the eighteenth century, it appeared in Lancaster County, Pennsylvania, resulting from a shipment of cattle from North Carolina into that State. But the extensive and serious outbreaks of this fever first occurred in Texas and in the states and territories over which Texas cattle were trailed toward the north. This gave it the name Texas fever. Better to call it tick fever because Texas is in no way responsible for it and the cattle tick is the only real carrier of the primary cause of the fever.

In 1889 Theobald Smith, then in the Bureau of Animal Industry, discovered the intra-corpuscular parasites in the blood of cattle sick or dead from tick fever. In 1889 and 1890 Kilborne found by field tests that the cattle tick was the carrier of this micro-parasite from the sick to the healthy cattle. From 1895 to 1900, Connoway of Missouri, and Francis of Texas, inaugurated the first blood inoculation experiments that were in any degree successful. Dalrymple of Louisiana, Roberts of Mississippi, Butler of North Carolina, Nesom of South Carolina, Willoughby of Georgia, Dawson of Florida, and Cary of Alabama, successfully employed blood inoculations to produce relative immunity to tick fever in non-immune or susceptible cattle. It might be well to say that many attempts were made to produce immunity to tick fever in cattle by inoculations with blood serum, and by artifi-

the micro-parasite to th
from these eggs carry t
or calf upon which the
time seed ticks molt, or
calf may have a high
pass through the old fe
ticks to get from one sic
ox or calf. When the r
of a cow, ox or calf whi
tick fever, the newly in
fever in six to ten days
the destruction of red b
broken up or disintegr
the coloring matter of
urea, carbon dioxide a
must be eliminated or
by way of the lungs, ki
cess of waste products
number of red corpusc
tion of the body as to
liver, spleen, kidneys, l
of the fever, the red c
thrown off by the kid
red in color.

THE BLOO

Texas fever is essent
tissue are so
or pathological cha
"red water" so commor
and the blood engorg
changes occurring in t

When the susceptib
the parasite (Piroplas
the average condiito
northern cattle is, *Hb
white cells 5,486 with

* Dimock and Thomp
1. This article on the
ner, assistant Veterina
Station.

1

she lays and the seed ticks
ro-parasites to the cow, or
ticks feed; and about the
their skin, the cow, ox or
The micro-parasites thus
ck, the egg and the seed
ox or calf to another cow,
rasites get into the blood
ot had a severe attack of
ow, ox or calf will have
ver comes as a result of
uscles or cells which are
the waste products are
od, organic substances,
. The waste products
t of the animal's body
n and bowels. The ex-
od and an insufficient
urb the natural condi-
er, and changes in the
owels. In acute cases
erial of the blood is
n the urine is blood

FEVER.1
of the blood in which
ly constant lesions
hemoglobinuria or
cases of Texas fever
both the result of

st inoculated with
by the seed tick,
as determined in
red cells 6,152,619,
ercentages of the

ev. August, 1906.
by Dr. Ward Gilt-
I. and Experiment

Drs. Connoway and Franc
test with the hematokrit in a
tion between the temperat
changes. The hematokrit is
means of determining the nu
volume of red cells will var
cases where many microcytes
reading will be very low whi
might be comparatively higl
to go into an extended critic
when its use is limited to volt
unable to establish any very
volume of red cells and the
although, of course, in a ge
erythrocytes is more or less
of fever.

A careful review of the
fails to show that the blood
termined by the hematcytom
ly with the temperature cu
ties exist in comparisons by
acute stages of the fever w
106 Fah., the red cells show
cent. while, during a later s
recovery, a temperature of
Fah. is attended by a destru
or the reverse may be not
there are serious and const
variably a fever. An exam
ture records (made in this
cases of Texas Fever (i. e., (
shows that there is no typi

A study of the Piroplasn
interest and profit. The g
doubtedly very rapid after
It attacks the red corpusc

* Drs. Connoway and Fra
Expt. Station.

is* made a very extensive
attempt to find some rela-
re curve and the blood
absolutely unreliable as a
ber of red cells, since the
with the size. In certain
re present the hematokrit
he actual number of cells
It is hardly worth while
of the hematokrit even
ric analysis. They were
ite relation between the
iations in temperature,
l way the volume of
eased during an attack

of Smith and Kilborne
in Texas fever as de-
rresponds at all close-
ll sorts of irregulari-
method. Often in the
emperature of 105 to
iction of only 20 per
iding either death or
rees to 102 degrees
high as 75 per cent.,
fact remains that
alterations and in-
about 200 tempera-
it) in experimental
blood inoculation)
ture curpe.
im is not without
ie parasite is un-
e into the blood.
ig them so much

To. 48, Mo. Agri.

toxin that might be utilize
at least a passive immunity
results of their experiments
the serum contains no toxin
physiological effects follow
ties, while it evidently cont
use has no effect in lesseni
quent or impending attack

Dalrymple, Morgan, and I
tion were able to confirm th
that the serum has no cura
tack has begun. In practic
ture i. e., the transfusion o
material is secured from a
one that has passed through
least has or has had ticks o
that in the ordinary immune
parasite to several million co
to one to fifty in fatal cases.
fatal cases the parasite is set
occurs there in many of the ir
in such cases and taken fr
doubtedly serve the same pu
as the entire blood, and it is
where the red cell destructi
blood may contain extra-cor
is doubted by Smith.

The number of corpuscles
1 per cent., but if this numl
usually attend. If recovery
sides, the number of parasite
writer have found Wright's
demonstrating the Piroplasm
of time to hunt and a mech
search, it is better to await a
from the heart muscle, kidne

August Mayer, having h
perience with the ticks, mak

d pracitcally in stimulating
in susceptible cattle." The
along this line indicates that
substance since no untoward
its use in enormous quanti-
ains no antitoxin, since its
ıg the severity of a subse-
f the fever.
odson of the Louisiana sta-
e results and show further
ve properties after the at-
ly all the work of this na-
blood or blood serum, the
o-called "immune" cow or
n attack of the fever or at
her. Schroeder estimates
attle there is not over one
uscles. This may increase
ls shown by Dr. Smith, in
ee in the blood plasma and
rnal organs. Blood serum
such sources would un-
se in producing immunity
ssible that in some cases
is severe, the peripheral
al parasites, though this

ected often reaches ½ to
is exceeded fatal results
s place as the fever sub-
reases. Dr. Cary and the
n most satisfactory for
d unless one has plenty
l stage to assist in the
case and secure smears
iver.

lisastrous personal ex-
t a strong case against

intense heat, severe exertic
certain undetermined fact
mal's resistance; or, on th
siderable increase in the
ganism, suffice to bring
tacks of the fever. Many
the soundness of this the
come safely South, south
South. The suggestion by
some one in the South ma
the blood of a herd of tick
ture secured in such an i
teresting comparison with
of northern cattle.

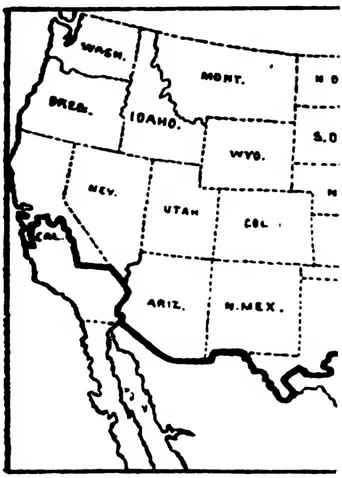
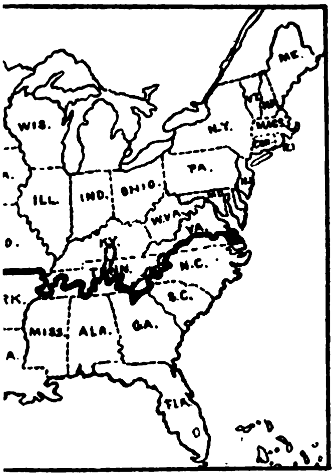


FIG 1.—Boundary line of
(From Bureau o

LIFE HISTOR

The large, fat femal
blood taken from its
under leaves, litter or
few days begins to la
may lay 1,500 to 4,000
gradually shrinks in si

adverse change of blood, or
tending to lower the ani-
:her hand, a slight or con-
nber of the invading or-
acute and often fatal at-
:s can be recalled to prove
Northern cattle can not
'attle can not stay safely
Schroeder is timely, that
ı extended examination of
ted cattle. The blood pic-
gation would make an in-
'sults at hand on the blood



ıfected with Texas Fever.
ustry Bul. 258.)

'ATTLE TICK.

ı completely filled with
to the ground, crawls
ıanure heaps and in a
six to fifteen days she
e female lays eggs she
ı a few days after lay-

A tabulated statement of the tick for summer and winter ma;

SUMMER.

May to October.................... Oc

1. Egg laying time—6 to 15 days 3
2. Hatching time—12 to 30 days 8
3. Seed tick may live without getting on cattle, horses or mules 30 to 120 days.
4. After attaching to the skin of cattle, females mature and drop off in 15 to 35 days ....

EXPLANATION (

1, larva of cattle tick (×25 mature female and eggs; 4, hi blood cells cells containin (× 1,000); 6, male cattle tic size); 8, young female cattle t size); 10, various stages of cat

e life history of the cattle
y be stated as follows:

WINTER.

ober to May.

to 60 days.

to 210 days.

to 240 days.

60 days.

—

URE 2.

me (natural size); 3,
wing cattle ticks; 5,
exas-fever protozoa
), 7, same (natural
5); 9, same (natural

. SYMP

1. The presence of
lead one to expect si
quently the ticks are
can not see or find th
applied to a non-imm
or calf may have a
may not be seen or f
Look closely and fee
on the escutcheon, on
the body.

2. Determine the
mals. Have they be
a tick infested one?
into the pasture? St
and non-immune. M
susceptible. All ver
cattle from above the
tick free places or fa

3. The temperatu
changes occur in the i
from 101 to 103 deg
from 103 to 107. T
night or late afterno
temperature may con
then drop to the norr
variable periods of
temperature. Just l
and sometimes to sub

4. The appetite is
and capricious in chr
pended in acute case
begins.

5. The bowels ma
pension of ruminatio
cate that the functio
pended. The lining c
may be more or less

OF TICK FEVER.

ll ticks or large ticks snouiu
ittle to have tick fever. Fre-
iall that the ordinary observer
Twenty-five infected seed ticks
iay produce tick fever. A cow
'ed seed ticks on it and they
by an inexperienced observer.
fully on the inside of thighs,
bdomen, drew lap and all over

'y of the sick animal or ani-
'ed from a non-ticky place to
ive ticky cattle been brought
attle are usually free of ticks
own cows are tick free and
; calves are susceptible. All
ntine line and all cattle from
; susceptible to tick fever.
before any other noticeable
animal. The normal ranges
.h. and the fever will range
perature will be higher at
in the morning. The high
r two to ten or more days,
chronic cases there may be
nd falling of the animal's
eath the temperature falls

acute cases and is variable
s. Rumination is also sus-
not resumed until recovery

ive. Loss of appetite, sus-
ctivity of the bowels indi-
alimentary canal are sus-
stines and fourth stomach
and the inactivity may be

around with head down an
come separated from the r
the shade and are fond of

11. Some cases become
violent. This is due to in
of blood to the brain or to
from the stomach or intes
inability to see may also be

12. An animal in fairly
flesh and becomes tucked u

13. Cows will often ab
or sometimes after a chron
lose their vigor and are ofte
or two years.

14. A small swelling ma
or between the branches of t
present in chronic cases and
a cough.

Diagnosis of

1. The positive test is fi
the red blood cells. This is
the animal dies, because it
plasma is found in the bloo
sufficient numbers to be easi
smears of the blood taken fr
kidney will usually contain
parasites. The blood may be
line methyl blue after it has
110 to 120 degrees C. for 2 h
main on the slide for one t
wash in water and then dip
third per cent. acetic acid so
of diffuse stain in the red blo
mount in water or dry and mo
examine by using immersion

With Wright's stain the bl
ing; keep the stain in the sli

k arched, and usually be-
f the herd. They prefer
.ding in the water.
and somewhat crazy or
ient or improper supply
ption of toxic materials
A wabbling gait and
ent.
condition rapidly loses
he abdomen.
ring or after an acute
ck of the fever. Bulls
ss for breeding for one

ır under the lower jaw
r jaw. This is usually
ıerally associated with

FEVER.

the micro-parasite in
difficult to do before
often that the piro-
skin or subcutis in
quickly found. Slide
heart muscle or the
ıs intra-corpuscular
with Loefflers alka-
ed by heating up to
he stain should re-
nd a half minutes,
instant into a one-
remove the excess
wash in water and
balsam or dry and
e slide.
will need no fix-
e to five minutes;

wash with water, dry and examine with high power. The writer was the first one to use Wright's stain in demonstrating the piroplasma of tick fever in the blood of cattle.

2. Black Leg or Black Quarter is often confounded with tick fever. This usually attacks young cattle under two years old and not very young calves or older cattle. It usually attacks fat yearlings instead of the poor ones. Before death and after death there is a swelling over the upper part of a front limb or hind limb or on some part of the body. This swelling crackles when the hand is rubbed over it, indicating the presence of gas under the skin. Cutting open the swelling permits a dirty red liquid to escape and exhibits muscle and connective tissue that appear as if they had been par boiled. Smears from this may be stained and the specific bacteria of black leg may be found. Also the material may be injected under the skin of a calf, sheep or a small laboratory animal and produce the specific disease.

3. Haemorrhagic septicaemia is not unlike a chronic case of tick fever. The presence or absence of the piroplasma will identify the one or the other. This characterized by well defined haemorrhages and numerous haemorrhagic spots under the pleura, peritoneum and epicardium. Sometimes the urine is stained red but not as frequently so as it is in tick fever. This disease is said to be caused by a specific germ (*Bacillus bovi-septicus.*) The outbreaks of this trouble are localized.

4. Anthrax may be mistaken for tick fever or the reverse may be true. In this the specific germ, *Bacterium anthracis,* may be found and it attacks horses, mules, cattle, sheep, goats, rarely hogs and occasionally man.

5. Stomach worms and hook worms in the alimentary canal may produce an anaemia not unlike that of chronic tick fever. In this, search for the worms in the feces of the suspected cases. These worms and tick fever may both be present in an animal at the same time.

TABLE I. *A Comparative Study of Four Specific Diseases.*

Disease	Haemerrhagic Septicaemia	Anthrax or Charbon	Black Leg	Tick fever
Cause	Bacillus bovisepticus	Bacterium anthracis	Bacillus Feseri	Piroplasma bigeminum (a protozoan)
How spread	Unknown	Food, water, flies, carcasses, etc.	Food, water, discharges, carcasses, etc.	Cattle ticks
Extent of single outbreak	Localized	Local centers and wide spread	Local. Often one farm or one pasture	Tick infested areas
Favorable season	Any season	Hot, dry weather after wet spring	Spring, summer and fall, hot and dry	Summer and fall but may occur any season
How germ enters body	Unknown	Digestive tract, lungs, skin	Skin (?)	Tick innoculation through skin
Susceptible Animals	Nearly all	Horses, mules, cattle, sheep, goats, man	Young cattle, sheep, goats	All cattle at some life period
Mortality	Very high	Very high	Very high	High in old cows and low in young cattle
Beginning and course	Acute, sudden. Chronic slow	Usually rapid	Generally rapid	Acute, rapid; chronic, slow
Local swellings	Slight or absent	Acute, occasional; Chronic, frequent	Very marked and gas under skin	Absent usually
Urine	Rarely blood stained	Often blood cells, stained or dark	Rarely blood cells stained or dark	Often blood stained or dark, albumen
Manure	Often blood stained	Often blood and mucus	Constipation and manure bloody	Blood stained, mucus and bile
Blood after death	Normal and clotted	Dark, tar black, clots, slow or slight	Normal, except at swelling	Thin, light in color and clots slowly
Haemorrhages	Often present and clearly defined	Spleen often ruptured	None	Usually none
Serous surfaces	Numerous blood spots on them	Blood spots and red serum in serious cavities	Serum in abdomen	Blood spots on epicardium and endocardium
Spleen	Normal, except surface blood spots	Large, dark and soft	Normal	Very large, soft, blue-black
Liver	Blood spots on surface	Engorged with dark blood	Usually engorged	Engorged with blood and bile
Kidneys	Blood spots on surface	Congested usually	Normal or engorged	Sometimes pale, usually engorged and black
Lymph glands	Blood stained near blood lesions	Often red or black and large	Normal	Slightly enlarged rarely red

After Death Conditions.

1. If the animal was sick for several days, the carcass will show emaciation, but fat animals may die suddenly and then the carcass indicates that the animal was in good condition as to flesh and nourishment.

2. In cutting through the skin it appears pale, as if there were little or no blood in the skin or subcutis. When blood is found in these tissues it appears "watery" or "thin" and does not coagulate readily.

3. The rumen or paunch may contain more or less semi-liquid material. The third stomach or manifolds, usually, in acute cases, contains very dry feed. The mucous membrane of the fourth stomach and of the small intestine will exhibit raw or eroded surfaces or patches. The contents of the intestines may exhibit an excess of bile, some blood and mucous, and the fecal matter may be soft or more or less dry and hard.

4. The spleen is usually enlarged or engorged with blue-black blood. A cut surface will let the contents flow out and it will appear like black-berry jam in color and consistency. This is broken down red blood cells and waste materials of the blood.

5. Kidneys are congested and often enlarged in acute cases. In chronic cases they may appear normal to the naked eye.

6. The bladder may contain red colored urine, dark colored urine, normal colored urine, or be empty. As a rule in a number of cases that die of tick fever, red urine will be found in some of the cases.

7. The liver is usually greatly enlarged and filled with blood and bile having a brown mahogany or yellow color. The gall bladder is distended and the bile is thick with flakes of mucous.

8. The lungs may be congested or may be normal.

9. The peritoneum and pleura may present a few colored patches or haemorrhagic spots or patches. These are not constant.

10. The heart may have the right ventricle "distended

with blood, full or clotted, according to the time elapsing between death and the examination. The left ventricle is usually firmly contracted and may contain a small quantity of fluid or clotted blood." (Smith.) The small haemorrhagic spots under the epicardium and endocardium are quite constant, they are more numerous on the outside and inside of the left ventricle.

11. The subcutaneous tissues, the mucous membranes of the mouth and eyes may become more or less yellow in acute tick fever cases. The fat of the body may be also yellow. The yellow coloring of white tissues is due to an absorption of bile. It is not always present. And yellow fat is not always due to tick fever. In many cases the mucous membranes of mouth and eyes are very pale.

12. Secure smooth slide smears of blood from the kidneys, the heart muscle and the liver. Stain with Wright's stain and examine with high power lens for the intra-corpuscular micro-parasite. Or examine with high power a fresh mount of blood from a kidney or the heart muscle for the micro-parasite.

*I*MMUNITY.

Immunity to tick fever is a relative term. It is not absolute. When an animal is not susceptible to an attack of a given disease, the animal is said to be immune to that disease. Immunity may be acquired by having the given disease one or more times, by natural resistance of certain species of animals for certain diseases, by introducing specific anti-toxins into the animal body. In tick fever, the only known means of producing immunity in cattle is by giving the animal one or more mild or severe attacks of the fever. Blood inoculation, or artificial tick infestation, are the only ways of artificially producing this immunity. Natural tick infestation may also produce immunity in a varying degree. The fact is that a cow, steer or ox must have an attack of tick fever once every year or several times every summer or its immunity is lost within two or more years. Just as a man can have a series of attacks of malaria so may cattle have a series

2. Inoculate any ti
the last of March, anc
cattle in the South ne
3. For the infected
steer or bull that has
that has had a gross
the second summer of
4. Secure a sterili
2 to 3 drams) having
ilized hypodermic nee
scalpel knife, three o
breakers or wide mou
rod or small sterile s
some 5 per cent. creo
5. Every animal
haltered in a narrow
6. Cast the two y
be drawn or secure i
hair or clip and shav
or vein and wash witl
ton. Have the assis
near the base of the
needle or an aspirati
the point forward ar
trates the vein the
needle. Catch the b
mouth bottle. When
let an assistant take
continuously with tl
quantity of blood dr
the number of cattle
ble after drawing tl
with blood and inocu
injecting one cubic
animal. The side of
convenient places fo
7. The dose of b
animal will take a r

2. Inoculate any time from the last of November to the last of March, and it is always best to inoculate the cattle in the South near the place where they shall live.

3. For the infected blood secure a two year old heifer, steer or bull that has had tick fever within a year, or that has had a gross infestation of cattle ticks during the second summer of its life.

4. Secure a sterilized hypodermic syringe (capacity 2 to 3 drams) having two or more strong and sharp sterilized hypodermic needles, a pair of scissors and a sharp scalpel knife, three or four small sterilized, one ounce, breakers or wide mouth bottles, containing a sterile glass rod or small sterile spoon; some absorbant cotton, and some 5 per cent. creolin or other good antiseptic.

5. Every animal to be inoculated should be tied or haltered in a narrow stall before the blood is drawn.

6. Cast the two year old from which the blood is to be drawn or secure it in a standing position. Clip the hair or clip and shave the hair over the jugular furrow or vein and wash with creolin solution and absorbant cotton. Have the assistant to press on the jugular vein near the base of the neck. Press the large hypodermic needle or an aspirating needle into the jugular inclining the point forward and inward. When the needle penetrates the vein the blood will flow freely through the needle. Catch the blood in the sterile beaker or wide mouth bottle. When the beaker or bottle is nearly full, let an assistant take it and stir the blood vigorously and continuously with the sterile glass rod or spoon. The quantity of blood drawn may be regulated according to the number of cattle to be inoculated. As soon as possible after drawing the blood, fill the hypodermic syringe with blood and inoculate the cattle as rapidly as possible, injecting one cubic centimeter under the skin of each animal. The side of the neck and over the shoulder are convenient places for the injection.

7. The dose of blood varies with the age. A young animal will take a relatively larger dose than an old one.

after the inoculation.]
die. But good care ma
In preparing for win
of rye, barley, winter
winter pastures. Nothi
inoculation fever bette
supplemented with plen
grain or concentrated f
a little cotton seed. D
inoculation, see that tl
infested with ticks. A
of pure water, and salt
Shade and running wa
hot cattle can wade and
a large number of inoc
come stunted, and are p

time that some cases
over.
on always sow plenty
vinter oats for green
ry cattle through the
ıty of green pasture,
ıay or silage and some
n, oats and shorts and
summer following the
never becomes grossly
ıre, with an abundance
nt reach are essentials.
;e pools into which the
l help. Remember that
ı tick infested cattle be-
ers for one or two years.

"	1	Bull	Ky.	18 mos.	.....	"	1	....	....		.....	"	.....	
"	1	Cow	Ky.	6 yrs.	.....	"	1	....	....	Cuba	.....	....	.....	
"	5	Bulls	Ky.	2 yrs.	.....	"	1	....	....	"	.....	....	.....	
"	1	"	Ky.	15 mos.	.....	"	1	....	1	Ala.	Clark	"	.....	First District Agricultural Soc...
"	1	"	Ky.	6 mos.	.....	"	1	....	....	La.	.....	"	.....	Bland M. Pleasant, La.
"	1	"	Ky.	5 mos.	.....	"	1	....	....	Ala.	Lee	"	.....	Floyd
"	1	"	Ky	15 mos.	.....	"	1	....	....	"	Chambers	"	.....	Andrews
"	1	"	Ky.	12 mos.	.....	"	1	....	....	Ga.	.....	....	.....	Maddox & Young, Moreland, Ga.
"	1	"	Ky.	3 yrs.	.....	"	1	1	....	Ala.	Lee	....	.....	Died 31 days after inoculation
"	1	H.	Ky.	2 yrs.	.....	"	1	1	....	"	"	....	.....	" 35 " " "
"	1	Cow	Ky.	6 yrs.	.....	"	1	1	....	"	"	....	.....	" 36 " " "
"	1	Bull	Ky.	14 mos.	.....	"	1	1	....	"	"	....	.....	" 39 " " "
"	1	Cow	Ky.	3 yrs	.....	"	1	1	....	"	"	....	.....	" 34 " " "
"	1	Bull	Mo.	1 ...	.....	"	1	....	....	"	Sumter	....	"	H. A. Haralson, Coatopa, Ala.

TABLE II. *Continued*

KIND OF CATTLE	No	Sex	Where Bred	Age	Immune	Non Immune	Times Inoculated	Deaths by Inoculation	Deaths During 1st Summer	State	County	Ticks Many	Ticks Few		
Hereford	1	H.	Mo.	1 yr.		yes	1			Ala.	Sumpte		yes	H. A. Haralson Coatopa Ala	
"	9	H.	Mo.	8to 18m		"	1			"	Dallas	yes		J. E. Dunaway, Orrville, Ala.	
"	1	Bull	Mo.	10mos.		"	1			"	"	"		" " "	
"	1	"	Va.	10 mos.		"	2			"	Lee	"		C. G. Lee, Opelika, Ala.	
"	40	H. & B.	Ky.	12mos.		"	3		6	"	Talladega			Giltner Thornton Cattle Co.	
Angus	2	Bulls	Mo.	8 mos.		"	2			Texas		"		Robert Adams, Alford, Texas,(Elliotts)	
"	1	"	"	10 "		"	2			Ala.	Lee	"		Whatley, Opelika, Ala. (Elliotts)	
"	5	"	"	7 to 10		"	2			"	Sumter	"		W. G. Little, Livington Ala. (Elliotts)	
"	4	Heifers	"	6 to 11		"	2			"	"	"		" " " " "	
"	4	"	"	8 to 12		"	2			"	Washington	"		H. K. Milner, Birmingham, Ala. "	
"	3	Bulls	"	8 to 14		"	2			"	"	"		" " " " "	
"	1	"	"	8 mos.		"	2			"	Talladega	"		N. C. Rew, Talladega, Ala. "	
"	1	Heifer	"	6 "		"	2			"	"	"		" " " " "	
"	1	Bull	"	6 "		"	2			"	Macon	"		C. F. Darnell, Notasulga, Ala. "	
"	2	"	"	12 "		"	2			"	Talladega	"		W. L. Thornton, Talladega, Ala. "	
"	1	Heifer	"	7 "		"	2			"	Lee	"		Ala. Experiment Station "	
"	1	Bull	"	12 "		"	2			"	"	"		" " " "	
"	1	"	"	12 "		"	2			"	Lowndes	"		J. E. Callier, Calhoun, Ala. "	
"	1	Heifer	"	7 "		"	2			"	"	"		" " " " "	
"	1	Bull	"	7 "		"	2			"	Colbert	"		J. S. Kernachan, Florence, Ala. "	
"	1	"	"	6 "		"	2		1	Cuba		"		W. F. Ward, Auburn, Ala. "	
"	1	Heifer	"	5 mos.		"	1			Ala.	Sumter	"		W. G. Little Livington, Ala.	
"	1	"	"	3 mos.		"	1			"	"	"		C. J. Smith, " "	
"	2	"	"	5 mos.		"	1			"	"	"		Allison Bros., Bellany, "	1904
"	1	"	Ky.	20 mos.		"	1			"	Lowndes	"		Norwood & Callier, Calhoun, Ala.	1905

TABLE II. *Continued*

KIND OF CATTLE	No.	Sex	Where Bred	Age	Immune	Non Immune	Times Inoculated	Deaths by Inoculation	Deaths 1st Summer	State	County	Ticks Many	Ticks Few	
Angus	1	Heifer	Ill.	33 mos.	....	yes	1	....		Ala.	Lowndes	yes	....	” ” ” ”
”	1	Bull	Ky.	9 mos.	....	“	1	....		“	“	”	....	” ” ” ”
“	4	”	Ky.	8-12	....	“	1	....		“	Wilcox	”	....	Boykin, Akerville, Ala.
“	5	Heifers	Ky.	8-12	....	“	1	....		“	“	”	....	” ” ”
Short Horn	34	“	Tenn.	8-18mos	....	“	1	....		“	Dallas	”	....	J. E. Dunaway 1903-'04
“	1	Bull	“	8 mos.	....	“	1	....		“	“	”	....	”
“	15	“	Mo.	12 to 15	....	“	2	....	5	Tex.	....	”	....	Amer. Short Horn Breeders Ass. 1904-05
“	1	“	Iowa	15 mos.	....	“	2	....	1	Ala.	Chambers	”	....	A. S B. A. Slaughter, LaFayette
“	2	Heifer	Mo.	12 to 15	....	“	2	....	1	“	“	”	....	A. S. B. A. ” ”
“	1	Bull	Mo.	12 mos.	....	“	2	....		“	Lee	”	....	” Edwards, Opelika, Ala.
“	2	H.	Mo.	10 mos.	....	“	2	....	1	“	“	”	....	” ” ” ”
“	1	Bull	Mo.	12 mos.	....	“	2	....		“	Dallas	”	....	” C. Kirkpatrick, Cahaba
“	1	“	Mo.	14 mos.	....	“	2	....		“	Perry	”	....	” S. L. Scott, Marion, Ala.
“	1	Heifer	Mo.	12 mos.	....	“	2	....		“	“	”	....	” ” ” ”
“	1	Bull	Kan.	14 mos.	....	“	2	....		“	Lee	”	....	” G. C. Floyd, Opelika ”
“	11	Heifer	Mo.	7 to 12	....	“	2	....		Miss.	....	”	....	” A. T. Stoval, Okalona, Miss
“	5	“	“	8 to 12	....	“	2	....		Ala.	Washington	”	....	” H. K. Milner
“	2	Bulls	“	12 mos.	....	“	2	....	1	“	“	”	....	” ”
“	1	“	“	12 mos.	....	“	2	....		“	Sumter	”	....	” W. G Little
“	1	Heifer	“	12 mos.	....	“	2	....		“	”	”	....	” R. Seale
“	2	“	Kan.	12 mos.	....	“	2	....		“	”	”	....	” ”
“	4	“	Mo.	10 mos.	....	“	2	....		“	Clay	”	....	” J. C. Street, Opelika
“	1	Bull	“	10 mos.	....	“	2	....		“	”	”	....	” ” ”
”	1	“	“	10 mos.	....	“	2	....		“	Lee	”	....	” T. Wimberly

TABLE II. *Continued*

KIND OF CATTLE	No.	Sex	Where Bred	Age	Immune	Non Immune	Times Inoculated	Deaths by Inoculation	Deaths During 1st Summer	State	County	Ticks Many	Ticks Few	
Short Horn	1	"	Mo.	12 mos.	....	yes	2	....		Ala.	Lee		yes	A. S. B. A. Ala. Expt. Station
"	1	"	Ky.	15 mos.	....	"	1	....			Dallas	yes	...	" C. Kirkpatrick Cahaba, '05
"	9	Heifers	Ky.	8 to 10	....	"	1	....			"	"	....	" " " '04
"	16	"	Ky.	6 to 10	...	"	1	....	6		"	"	....	" " " '05
"	2	Heifers	Ky.	4 to 7	....	"	1	....	1		Marengo	"	.....	R. Seale Livingston, Ala.
	1	Bull	....	6 mos.	....	"	1	....			Sumter	"	....	Edmonds, Coatopa, Ala.
	1	Bull	....	4 mos.	....	"	1	....			Sumter	"	....	J. L. Horn, Coatopa, Ala.
"	1	Bull	......	10 mos.	....	"	1	....			Butler	"	......	J. T. Watt, Greenville, Ala.
"	1	"	Mass	8 mos.	....	"	1	....			Elmore	"	......	W. E. Benson, Kowaliga, Ala.
"	2	"	......	4 to 7	....	"	1	....	1		Marengo	"	......	R. L. Seale, Livingston, Ala.
"	9	Cows	Pa.	1 to 16y	....	"	1	2			Macon	"	......	Tuskegee Normal School 1903-1904.
"	3	Bulls	Pa	2 to 3	....	"	1	....			Macon	"	.....	" " "
"	5	Bulls	Ky.	8 to 12	...	"	1	....			Talladega		....	Giltner Thornton Cattle Co.
"	6	Bulls	Ky.	8 to 12	....	"	1	....			Wilcox		.....	B. L. Boykin, Ackerville, Ala.
"	37	Heifers	Ky.	8 to 12	...	"	1	....	2		Wilcox		....	" " "
Gurnseys	11	Cows	N.Y.	1 to 12	...	"	1	2			Macon	"	....	Tuskegee Normal School 1903-1904
Holstein	7	Cows	Pa.	2 to 9	....	"	1	2			Macon	"	......	" " " "
"	1	Heifer	N.Y.	8 mos.	...	"	1				Sumter	"	......	W. K. Pickens Livingston.
Jerseys	9	Cows	Pa.	1 to 12y	....	"	1	2			Macon		...	Tuskegee Normal School 1903-1904.
"	3	Cows	Ky.	4 to 12	....	"	1	7			Lee		....	1903-1904
Grades	70	Cows	Pa.	1 to 16	....	"	1-2	1	2		Macon	"	.....	Tuskegee Normal School
"	1	"	Ky.	7 yrs.	....	"	1						......	
"	1	"	Ky.	6 yrs.	....	"	1						....	
"	1	"	Ky.	4 yrs.	...	"	1						......	
"	1	"	Ky.	15 yrs.	....	"	1		1				......	
Total 448					....			21	48				......	
" 45					...				4				......	No. inoculated previous to the 448
Total 493					..			21	52				....	Total No. up to Jan. 1 1906.

Table II gives a record of all blood inoculations up to January 1, 1906:

The percent of deaths from inoculation is	4.26
The per cent. of deaths the first summer after inoculation	10.54
The total per cent. of deaths	14.80

One hundred or more of these cattle were too old and not a few were either too fat or too poor to withstand the inoculation. Out of 106 inoculated at Tuskegee, 15 died of inoculation fever and only one died during the first summer. The majority of the 106 were over two years old. While the average per cent. of deaths is high, taking the cattle at any age as they come and in all conditions; with a great variety of kinds of care and treatment, the losses are not as great as one should expect were like conditions presented.

Selected Temperature Records Following Blood Inoculations for Immunity.

TABLE III

DATE		46		169		58		82		37		86	
1904-1905		am	pm	am	pm	am	pm	am	pm	am	pm	am	pm
December	1	103.8	106.1	102	103.1	101.3	102.3	104	105	103.1	104	101.2	103.3
	2	103.2	103.8	104	104	104.2	104.1	104	104.4	103.4	103.8	104.3	104
	3	104.5	103.9	104	103.9	104.2	104.5	104	104.1	102.2	105.4	103.5	105.4
	4	102.9	102.5	103.8	103.1	104	103.4	104.9	103.2	105.4	103.5	104.2	104
	5	103.8	103.5	105	103	103.2	104.5	104.5	104.2	104.5	105	103.9	104.5
	6	101.5	103.8	103.1	102.8	101.4	102.5	105.1	104.5	103.4	104.8	102.9	104.2
	7	101.8	102.9	101.8	104.5	103.4	103.4	104.9	105	103.1	104.5	105	106.1
	8	105.4	104	102.8	102.2	105	104.4	103.5	104.8	104.8	105.5	105	104.2
	9	104	105.9	102	102.2	104.5	104.1	104	105.1	105.1	106	105.9	105.9
	10	105.9	104.1	103.4	102.5	105.1	104.8	104.1	101.8	105.5	106	104.5	105
	11	101.5	106	101.5	102.9	104.8	104.1	103.5	103.1	102	103	104.5	102.9
	12	103.1	103.8	102.8	102.2	102.5	101	103.5	103.1	103.5	102.9	104.8	103.8
	13	101.9	104	102	103.8	101	102	101	103	101.5	101.9	103	103.8
	14	103.9	101.8	101.2	102.4	101	101.3	103.1	103.1	102.9	102.9	101.1	102.9
	15	102	102.3	101.9	102.3	101	101.3	103.8	103.6	103.9	103	101.9	102.8
	16	101	102.4	102.1	101.9	101.9	102	103	104	104	103.1	101.5	101.5
	17	102	102.4	102	102.6	102	102.5	104	102.8	103.2	102.6	103.9	103.3
	18	101	102.5	102.5	103	101.8	102	104	106.4	103.1	102.9	102.1	104.5
	19	101	102.9	101.8	102.9	103	102.9	102	103	102.1	103.2	102.9	103.8
	20	101	103	102.4	103.8	102.1	103.2	102.9	104.5	101.9	102.8	103.9	103
	21	101.5	104	102	103.5	103	104.9	102.4	103	102	103.2	102.9	104.5
	22	101.8	101.9	100.9	102.9	104.5	106.9	103.9	103.5	102.8	103.4	102	102.9
	23	102	103.8	101.8	103.8	106.5	106.9	103	103.8	103.5	106	102	103.5
	24	102.9	102.4	102.8	101.8	105	102.6	103.8	101.5	105	102.4	102.8	100.2
	25	103.4	104	103.4	102.4	102	103.2	103.5	104.6	102.6	102.8	103	103
	26	103.8	104.2	103.4	102.3	102	104.6	104	106.1	103.2	102.5	103.2	103.3
	27	102.5	99	102.6	101	102.8	100.[illegible]	104.6	103	103.5	99.6	104	100.3
	28	101.3	101.9	103.6	103.3	101	103.3	102.2	101.8	101.8	104.5	101.3	102
	29	101.7	102	102.8	103.5	101.5	102.9	101.3	102.9	101.7	102.4	102.2	102 4
	30	101.2	102.8	104	105.4	102	103.2	102.9	103.5	101	101.9	105.5	104.4
	31	102	102.9	102.5	104.5	103.5	103.8	104	104	101	103.2	100.9	103.8
January	1	101.4	102.9	102.2	103.9	103.9	105.2	104	105	101.9	102.6	103	104.4
	2	103	102.8	102	105.5	103.9	103.9	105	105	102.9	103.2	102	100
	3	102	103	102.9	105.2	103.9	104.2	103.9	105.5	102.8	104.2	102.9	103 5
	4	102.5	102.9	100.9	104.8	101.9	102.5	105	103.9	102.9	103.8	102	104
	5	103.5	104	102	104.5	102	103.5	105.8	103.6	103.5	104.9	103	103.6
	6	103.5	103.9	104.5	104.5	103.9	103.6	105.4	104.8	104.5	103.5	103.5	104 5
	7	102.5	103.8	103.4	105.2	102.9	104.2	104.2	105.9	103.9	104.5	103.5	104
	8	104	104.5	104	104.9	103.8	104.9	103.6	107	105	105	102.5	104
	9	103.9	103.8	103.4	103.9	104	105	103.2	104	104.4	102.5	104.4	104.5
	10	104	103.2	103.5	104.8	103	104.8	103.5	103.8	104	105.8	105	105.2
	11	103	102.2	102.5	104	105	102.9	104.4	105.5	104	106	104	104.5
	12	103.2	102	104	103	104.9	103	105	103.5	105.2	105	105.5	104.2
	13	103	102.5	104.2	102.5	103.2	102.8	104.5	102.5	105	104.5	105	103.8
	14	102.5	104.5	102.4	102.5	102.9	102	102	103.5	103.5	101.2	104.4	103.8
	15	101.9	104	101.8	102.5	101.5	102.2	102.8	101.5	104	104	102.8	105
	16	104	104.5	101.5	103.5	101	102.5	101.8	102.8	103.2	104.5	102 4	104 8
	17	102.4	103	100.9	104	100.5	102.5	102.4	103.5	103	104	101.5	103.2
	18	102	103.2	100.5	102	101	102	103	104	103.5	104.4	101.2	103
	19	102.5	103	101.9	101.9	102.5	104.5	104.5	104.5	103	103.5	103	102 5
	20	102.9	102	101	101.5	104.5	103.5	103.9	102	103	103	103.5	103
	21	101.4	102.5	101.5	101.5	103	104	102.9	104.5	102.5	102	101	103.2
	22	101.5	102.5	102	101.5	102.5	101.5	103.5	102.5	102.5	104	101 5	103 4
	23	101.9	101	101.5	100.5	100.4	102.9	101.9	101.5	102 5	102 5	102 4	102
	24	103.4	102.5	100.5	101.9	101.5	101.8	103	103	101	102.8	101.9	103
	25	100.9	101	101	102	100.5	101.2	102.5	101.5	102	[illegible]	101	101.9
	26	101.5	102.5	102.5	101.9	100.5	102.5	102.4	101.9	101.5	101.5	101 5	101
	27	102.2	102.5	103.2	102	101.9	101.2	102.5	102.9	101	103.2	102.5	102.5
	28	100.4	103	101	102	101.4	101.8	102.9	102.5	102	100.5	102	103
	29	101	102.8	100.9	101.2	102	101.2	101.9	102	101.5	102.9	101.8	101.4
	30	102	102.8	102.8	101.5	102	102.4	103	102	101.5	100.5	103.2	101.5
	31	101	102.9	102.5	102	101.5	102.5	101.5	103	102.5	101	103.5	104

TABLE III. Continued

DATE 1904-1905		46 a m	46 p m	109 a m	109 p m	58 a m	58 p m	32 a m	32 p m	37 a m	37 p m	86 a m	86 p m
February	1	101	101.5	101.5	101.5	102.2	101.9	101.9	102.5	101.9	101.5	102	102.9
	2	101	101.5	101.2	102.5	101.5	102	104.5	102	102	102	102	101
	3	102.5	102.5	102.5	102.9	101	100.9	101.9	102	102.9	102.5	102	102.9
	4	100.9	100.5	101	102	101	101.5	102	102.2	102	100.9	101	102.2
	5	102	102.5	101	102.9	101.2	102.9	103	102.5	102	102.5	100.5	101.5
	6	101.5	102	102.9	101.5	101.5	101.9	103.1	102	103.5	102	102	100.9
	7	100.5	101	101	102	101	102.9	101.5	101.5	101.9	102	102	100.9
	8	101.5	101.5	101.5	101.5	102.5	103.2	102.2	102	102	101.5	100.5	102.5
	9	101.5	102	102.4	102.2	102	102	102.8	102.5	101.9	103.5	102.4	103
	10	101.5	102	101	103.2	101.8	102.5	102	102.5	101	103	103.5	103.9
	11	103	102	102	102.2	102	101.5	102	102.5	103	101.5	100.9	102
	12	101	101.4	102.5	102	100.5	102.5	103.6	102.3	101.8	101.5	101.4	101.6
	13	102	100	101	101	101.5	102.4	102.8	101.2	102.5	100.5	102	100
	14	101.5	102.3	101	102.2	102	103.5	101.5	102.9	101.6	102.5	100.2	102.5
	15	101.4	101.9	101	102	100.8	102.5	101.4	101.5	101.6	102.5	101.5	102 5
	16	100.2	102.5	100.5	101.5	101	102.5	101.8	102	100.3	101.5	101.8	102 5
	17	101.9	102.5	101.5	103	102	102.5	101.5	102.6	101.8	102.8	101.5	102 6
	18	102.5	102.5	100.6	102.8	104.5	104.5	101.9	101	101.5	102.5	101.5	102.9
	19	102	102.5	102	103.2	105	104.5	101.5	102	102	100.5	100.9	101.5
	20	102	103	103	102	102.9	104.3	101.5	102.9	101.2	102.2	102	101.8
	21	102.5	103	102	102	103.2	105	102	101.9	100.2	102	101.5	102
	22	101.5	101.6	102	103	102.6	101.2	102	103.5	101.9	103.8	102	103.2
	23	101.5	102	102.5	102.5	102.9	103	102	103.5	102.9	103.2	103.5	102.8
	24	100	102.5	102.5	102.5	100.5	102.5	101.5	102.9	102.9	103	101.9	101
	25	102.5	103	102.9	103	101.5	102.5	102.9	103	103	103	102.9	103.5
	26	101	101.9	102	104	103	102.5	102.5	103.5	102.5	104	102.5	101.5
	27	102	103 .4	101.5	104	101.4	103	102.5	103.5	102.5	103.5	101	103
	28	102.8	102.8	103	103.4	103.8	103.5	102.5	103.5	102.5	103.5	102	102.9
March	1	103	103.8	102	103	102.9	103	102.2	103.5	103	104	102	102.5
	2	104	101	103.5	104	102.5	103.4	102.5	105	104.5	104.2	102.5	103
	3	100	101.5	102	103.5	102	103.5	102	104	103.5	105	100	102.2
	4	101.5	102.9	103	104	101.5	102.9	103	104.2	102	104	101.9	103
	5	.....	.....	104	103.5	102	103.5	103.5	105	103.5	104.5	101.5	104.5
	6	.....	.....	103	103.9	104	104.5	104.5	104	104.5	105.2	103.5	103.9
	7	.....	.....	103.5	103.5	101.5	103	103.2	104.5	103.5	104.8	101.9	102 6
	8	.....	.....	102	103.5	104.2	104	101	102	104.2	105	103	103.5
	9	.....	.....	101.5	102.3	103	104	102.5	103.4	102	103.5	103	103
	10	.....	.....	103	[illegible]	102	102.5	100.9	102.6	103	103.5	103	103.1
	11	.....	.....	[illegible]	[illegible]	100.9	101.5	102	101.9	103.5	102.6	101	101.5
	12	.....	.....	102.9	103	101.9	102.5	101.5	101.9	102.5	103	101.9	103
	13	.....	.....	102.5	103.6	102	102.5	102	103	102.9	102.9	102	101.5
	14	.....	.....	102.2	103.5	101.5	103.5	102	103.6	102.5	104	101.5	102.2
	15	.....	.....	102.9	104.4	101.2	103.2	103	103.8	102	104.5	101.2	103.5
	16	.....	.....	103	105	103	104.2	105	104.5	102.2	104.6	103.2	102
	17	.....	.....	103	104.2	101.2	103.9	103	103.6	103.5	104.9	103	103.5
	18	.....	.....	102.5	104	102	103.5	101	103.9	102.5	103.9	102	103.5
	19	.....	.....	102	103.2	102.5	104	103	103.5	103	104.9	102	103.9
	20	.....	.....	102	103.5	101.9	104	102	104	102	104.2	102	103.2
	21	.....	.....	102	103	102	103.7	102.9	103	102.5	104.5	102.3	103.5
	22	.....	.....	103	102.5	103	104	102.8	104	103	104.9	102.5	103.5
	23	.....	.....	102	103.9	103.5	103	102.5	103.9	104	104.5	102.5	103
	24	.....	.....	102	102	101.9	104	102.5	104	103.5	105	102.5	103.9
	25	.....	.....	102	102.5	103	104	[illegible]	104	104	104	102.5	102.9
	26	.....	.....	101.9	102.9	101.9	104.5	102	103.9	103	104	102	103.5
	27	.....	.....	101.5	102.9	101.2	104.5	102.5	103.9	101.5	105	102	104
	28	.....	.....	101	102.5	102.9	105.5	102.9	103	102.5	105	103.5	104.5
	29	.....	.....	.....	.....	101.5	102.5	.....	.....	104	104.4	101.5	102.2
	30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table of Selected Temperature Records of Inoculated Cattle that Died of Inoculation Fever.

TABLE IV.

DATE		588		649		641		650		648		609	
1907		am	pm	am	pm	am	pm	am	pm	am	pm	am	pm
January	16	100.8	101.2	101	101.2	104	101.4	101	106.3	101	101.2	101.6	101.8
	17	101.2	102	101	101	101	102	102.4	102	101	101	101.6	101.8
	18	104.4	100.6	100.6	101.6	101	101.6	102.4	100.2	101.4	101.6	101	102
	19	101.2	102	101.8	101	100.8	101.4	102.2	101	101.3	101	101.4	100.8
	20	101.6	103	101	101	101	102.4	100.4	102	102	101.4	100.4	101.8
	21	101.6	104	101.8	104	102.4	102.2	102.2	104.2	100.4	101	101.4	102
	22	105	104.8	105	102.2	104.6	105.6	101.8	101	101	101.6	101.8	102.6
	23	101.4	104	102.6	105.8	104.4	102.8	100.4	102.2	101.8	102.2	101.4	102
	24	100	101	105.6	105	104	104.8	101.4	102	103.6	104	101	102.3
	25	102.2	102	104	100	102	105	101.6	101.2	102	102.4	101	102.1
	26	100.4	100.6	99.8	101.8	102	102	101.2	98.4	101.2	103.6	101.8	102
	27	101.6	104	101.2	101	101.6	101.4	102	102.4	101	104	102.2	102
	28	101.6	101	102.2	102.8	101	101.4	100	101.8	103	103.4	101.8	99.3
	29	101.4	100.4	103.4	101.4	102.5	102.6	101.6	99.5	104	105	101.6	101
	30	102	103.8	102	103.4	101	102.4	102	102	102	103.2	101.6	101.4
	31	101.4	102.4	103.4	104	102.2	102	102	104.6	103	101	102.4	103
February	1	102	103	102	103	103	102.2	100.6	102	103	102	102.4	101.8
	2	101.4	103.2	102	101.2	103	104.6	101.6	101.6	101	102.2	102	103
	3	103.8	103.2	102	103	103	101.9	101.2	101.2	101	102.2	102	103
	4	100.6	103	102.2	103	103	103	101	104	101.7	102	102.2	102.4
	5	100	103.2	101.6	102.2	103	102.8	101.2	103.2	101	103	101	102
	6	101	103	103	103	102.8	103	102	102.8	101.2	103.2	102	103
	7	102.2	102.8	102	102.2	103	103.4	103	103	102.1	102.8	101.8	102.2
	8	102.6	104.2	102.4	102	102.2	105.6	101.6	102	102	104	101.8	106.2
	9	103.4	103	103	102	104.3	104.9	101.6	102.3	103	103.9	104	104.2
	10	102.8	102.8	101.2	102.3	103	105.3	102	102.4	101.8	102.5	103	105
	11	101.4	100	102.2	99.4	104	105.4	101	100.2	100.8	100	104.4	105
	12	104	104.6	101.4	102.4	104.6	104.2	101.8	102	101	102.7	103.8	104.2
	13	104.8	104.8	102	101.4	103.2	103.6	101.8	100.8	101	104	99.2	101.6
	14	104.6	103.2	101	101.6	104	105.6	101.8	100.2	104.4	103.8	103	104.6
	15	99	101.8	101.4	102.8	102.8	102.6	102.2	102	100.2	100.8	98.5	99.4
	16	99	.....	101.6	102	102	103.4	101.7	100	101.4	101.2	100	100
	17	.....	.....	102.6	103	104.2	105.6	102	102	101.4	103.6	100	100.5
	18	.....	.....	103.8	104	101.6	102.3	102	101.6	102.6	102	.....	.....
	19	.....	.....	102.6	103.4	104.2	104	103.8	99.1	103	104	.....	.....
	20	.....	.....	102.6	103.4	103.5	104	101.8	.....	102.2	103	.....	.....
	21	.....	.....	102	102.6	104	103.2	.....	.....	103.2	102.2	.....	.....
	22	.....	.....	103	105.4	104	103.8	.....	.....	103.6	104.5	.....	.....
	23	.....	.....	98	101.8	104	105.6	.....	.....	103.4	102.3	.....	.....
	24	.....	.....	102	105	102	105.6	.....	.....	101	101	.....	.....
	25	.....	.....	102	105.4	98.5	104.6	.....	.....	100.2	100.6	.....	.....
	26	.....	.....	99	102	101	105	.....	.....	.....	.....	.....	.....
	27	.....	.....	100.2	104	102	103.6	.....	.....	.....	.....	.....	.....
	28	.....	.....	101	102.4	100.8	101.3	.....	.....	.....	.....	.....	.....
	29	.....	.....	101	.....	100	102	.....	.....	.....	.....	.....	.....
March	1	.....	.....	.....	.....	100	101.4	.....	.....	.....	.....	.....	.....
	2	.....	.....	.....	.....	99.4	101	.....	.....	.....	.....	.....	.....
	3	.....	.....	.....	.....	102	100	.....	.....	.....	.....	.....	.....
	4	.....	.....	.....	.....	98	99	.....	.....	.....	.....	.....	.....
	5	.....	.....	.....	.....	98.5	98	.....	.....	.....	.....	.....	.....
	6	.....	.....	.....	.....	98.8	.....	.....	.....	.....	.....	.....	.....
	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE IV. *Selected Records of 15 Deaths from Inoculation*

Number of the Animal	Days after 1st Inoculation Died	Days af er 2nd Inoculotion Died	Highest Temperature	Lowest Temperature	Age, Breed, Condition of Animals, Etc.
691	13		107.4	97.8	Grade Jersey
611		22	105.6	99.8	
607	11		107.2	100.6	
649	46		105.8	98.	
580	17		106.8	96.	
655	18		107.2	99.8	
650	37		104.6	98.4	Very fat Gurnsey 12 yrs. old
648	41		105	100.	Very old cow
609	35		106.2	98.5	Jersey cow, 9 yrs. old
646	13		106.4	100.	
623	18		106.8	100.4	Holstein cow, 8 yrs. old
658	13		107.2	103.	Short Horn cow
654		9	107.	100.	Short Horn cow, 4 yrs. old
538	33		104.8	99.	Grade Holstein cow, 7 yrs. old
644	52		105.6	98.	Grade Gurnsey cow, 8 yrs. old

This table shows that a small number die after the second inocululation and that the temperature falls to sub-normal just before death.

The following descriptions of eight kinds of ticks were compiled by Mohler from Salmon and Stiles' work on "The Cattle Tick" and these and Figs. 1, 2, 3 and 4 are taken from Farmers' Bulletin No. 258 of the Bureau of Animal Industry, Department of Agriculture, Washington, D. C.

TEXAS FEVER, OR CATTLE, TICK (*Boophilus annulatus.*) —Figure 3, No. 1a, shows the natural size of an adult female Texas-fever tick, whose characteristic markings are better brought out in No. 1, magnified four times.[a] This tick may be readily distinguished from the other seven ticks by the small size and the color of the head and shield, the so-called head parts, whose lateral borders are straighter and more parallel, as shown in No. 1b. These head parts are short and relatively broad and dark reddish brown or chestnut brown in color, appearing as a convex plate on the median line at the fore end of the

a In figures 3 and 4 various ticks that infest cattle are shown as follows: The natural sized nature female tick, this tick mangnified four times, and the head and shield of the same enlarged ten to fifteen times.

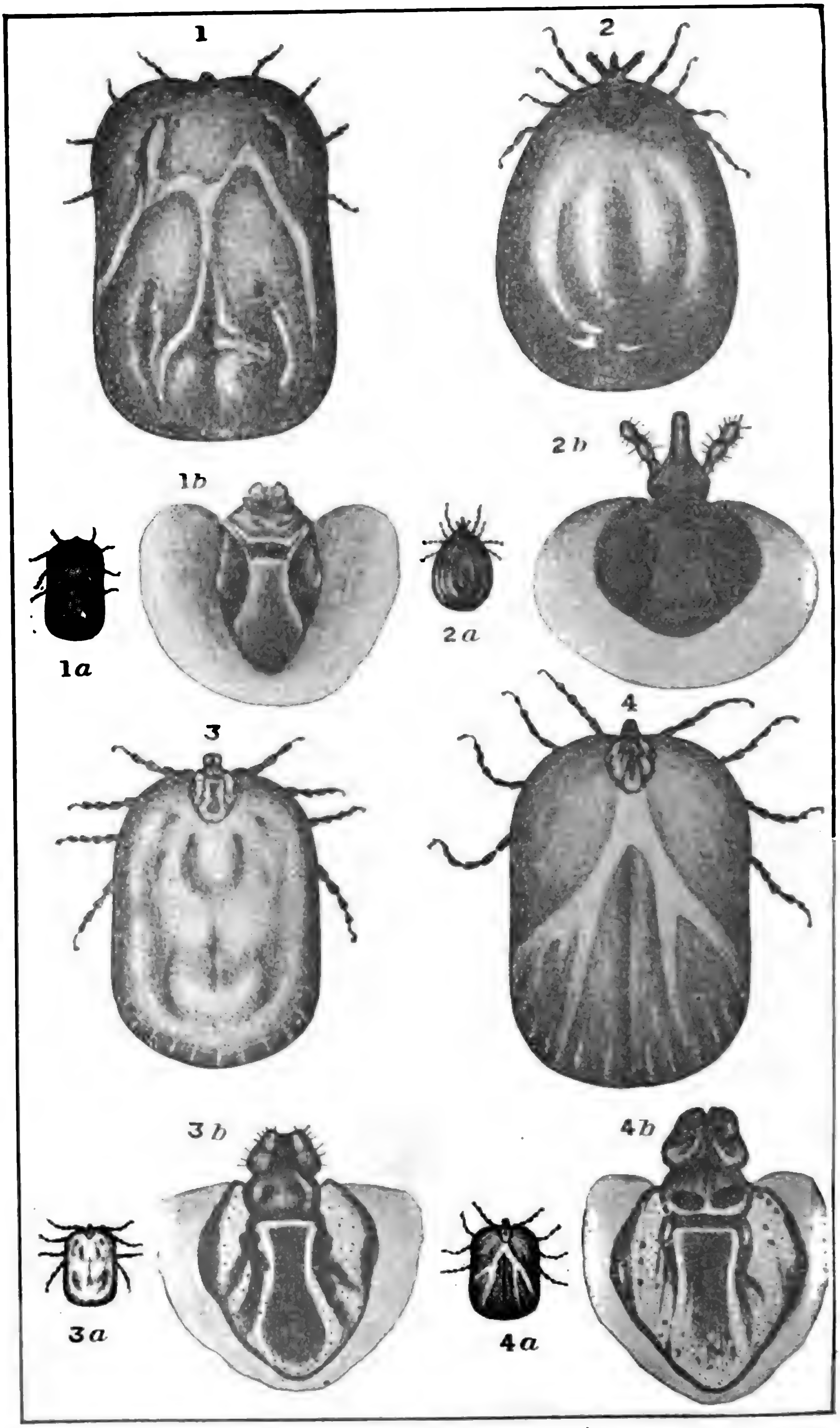


FIG. 8.—Various ticks that infect cattle

tick. The body is oblong oval in shape and may reach one-half inch in length. The color varies from a dull yellow to an olive brown; often it is mottled with irregular areas of yellow and brown or streaked with wavy lines of these colors. Two grooves or indentations are seen running from the front to the rear on the skin of the back, which become almost, if not entirely effaced at about the middle of the body. Another groove is seen between these two grooves in the posterior half of the body. These grooves are caused by the contraction of the muscles of the body and therefore vary considerably, entirely disappearing when the tick is full of blood. They are very distinct when the ticks have been removed from cattle several days. The four pairs of legs are brown, moderately long, and very slender. This tick is found principally on cattle, less frequently on horses, mules, and asses, and in one case it was found on a deer. The Federal quarantine line indicates the northern boundary of the section of the United States infested with fever ticks.

CASTOR-BEAN TICK (*Ixodes ricinus.*)—The body of this tick (fig. 3, Nos. 2 and 2a) resembles in shape that of an eggplant, and it takes its name from its similarity to the bean of the castor-oil plant. It is lead colored, with a variegated mixture of yellowish red, brown, or gray. The body contains two anterior grooves that slightly diverge from each other, and three posterior grooves, the middle one of which is straight, while the other two are curved outward. The mature female is from three-eighths to seven-sixteenths inch long and has four pairs of dark-brown thin legs. The head and adjacent shield are a shiny dark brown or a chestnut brown, the latter portion being five-sided, like a pentagon (No. 2b), with lateral borders prominent and rear angle rounded. Two stout and well-developed feelers (palpi) may be seen extending outward on each side of the head. This tick has been collected from sheep, cattle, goats, horses, deer, dogs, cats, foxes, rabbits, birds, man, and a few other animals.

It was one of the first ticks studied, and has a very wide distribution in the United States.

NET TICK (D*ermacentor reticulatus.*)—The body of the adult female tick is oblong oval, five-eighths inch long, and of a deep brown or slate color (fig. 3, Nos. 3 and 3a). It has four pairs of brown legs of moderate length. The skin of the back and head is covered with fine points, or punctations, which almost disappear at this stage. Besides the grooves that are located like those in the cattle tick, there is a marginal groove extending around the body just inside the border. There are also eleven small indentations (festoons) arranged about the posterior margin of the body. These festoons and grooves become shallow or effaced in the adult stage. The shield portion of the head parts has a silvery white metallic rust extending along the two sides and posterior portion (No. 3b). It may have a rose or greenish tinge. The head is larger than that of the cattle tick. The net tick has been found on man, cattle, horses, sheep, and deer; and in this country it seems to be most common in the West, especially in California, Texas, and New Mexico.

AMERICAN DOG TICK; ALSO CALLED WOOD TICK (*Dermacentor electus*).—This tick (fig. 3, Nos. 4 and 4a), resembles the net tick (*Dermacentor reticulatus*) so closely that a hand lens must be used to distinguish between them. However, it can be readily known from the Texas fever tick by the fact that the so-called head parts are longer and broader (No. 4b). Here there is also a yellowish white rust in the posterior portion which extends anteriorly along each side as two bright, iridescent lines separated by a central brownish area. The body is oblong oval in shape and measures as much as three-fifths inch in length. The skin of the back contains grooves like those found in cattle ticks, and, in addition, another groove extending around just inside the margin, together with eleven smaller grooves (festoons) on the posterior border. These lines, so distinct in the young female, become shallow at maturity. This tick has been found on

man, cattle, dogs, horses, rabbits, and panthers, and has been collected in woods and on uncultivated lands in many sections of this country, especially in eastern United States.

LONE STAR TICK (*Amblyomma americanum*).—As indicated by Nos. 5 and 5a of figure 4, the body of this tick is oblong oval and of a yellowish gray or brown color. The skin is rough and puckered unless the body is full of blood. The reddish brown area at the front of the tick is composed of the head and head shield. The latter extends backward a short distance to form a triangle, in the apex of which is a white or metallic-yellow spot from which it derives its name "Lone Star" (No. 5b). The mature female may reach one-half inch in length and has four pairs of long thin legs. This tick has been found on cattle, dogs, horses, sheep, goats, hogs, and man, and is very widely distributed in the United States.

EAR TICK (*Ornithodoros megnini*).—As will be observed from Nos. 6 and 6a, figure 4, the shape of this tick is similar to that of the body of a violin. It is nearly twice as long as broad, rounded at both ends, narrower behind than in front, and slightly constricted in the middle. In color it varies from gray or brown to violet, and has two grooves behind the head, with a middle one in the posterior portion. On the skin of the back are numerous minute spines, or stiff hairs. The adult females are from one-fourth to three-eighths inch in length, and have four pairs of long stout legs. The anterior portion of the tick is curved downward to form a cover for the very small and short head, which can only be seen from the under side of the tick. The feelers (palpi) and beak, however, stick out from under the front part of the body and can be seen from above (No. 6b). This tick is found in the ears of cattle, horses, mules, asses, and other animals in the South and West.

CHICKEN TICK (*Argas miniatus*).—In shape and appearance this tick is like an enlarged bedbug, and is of a uniform reddish brown color, with four pairs of lighter

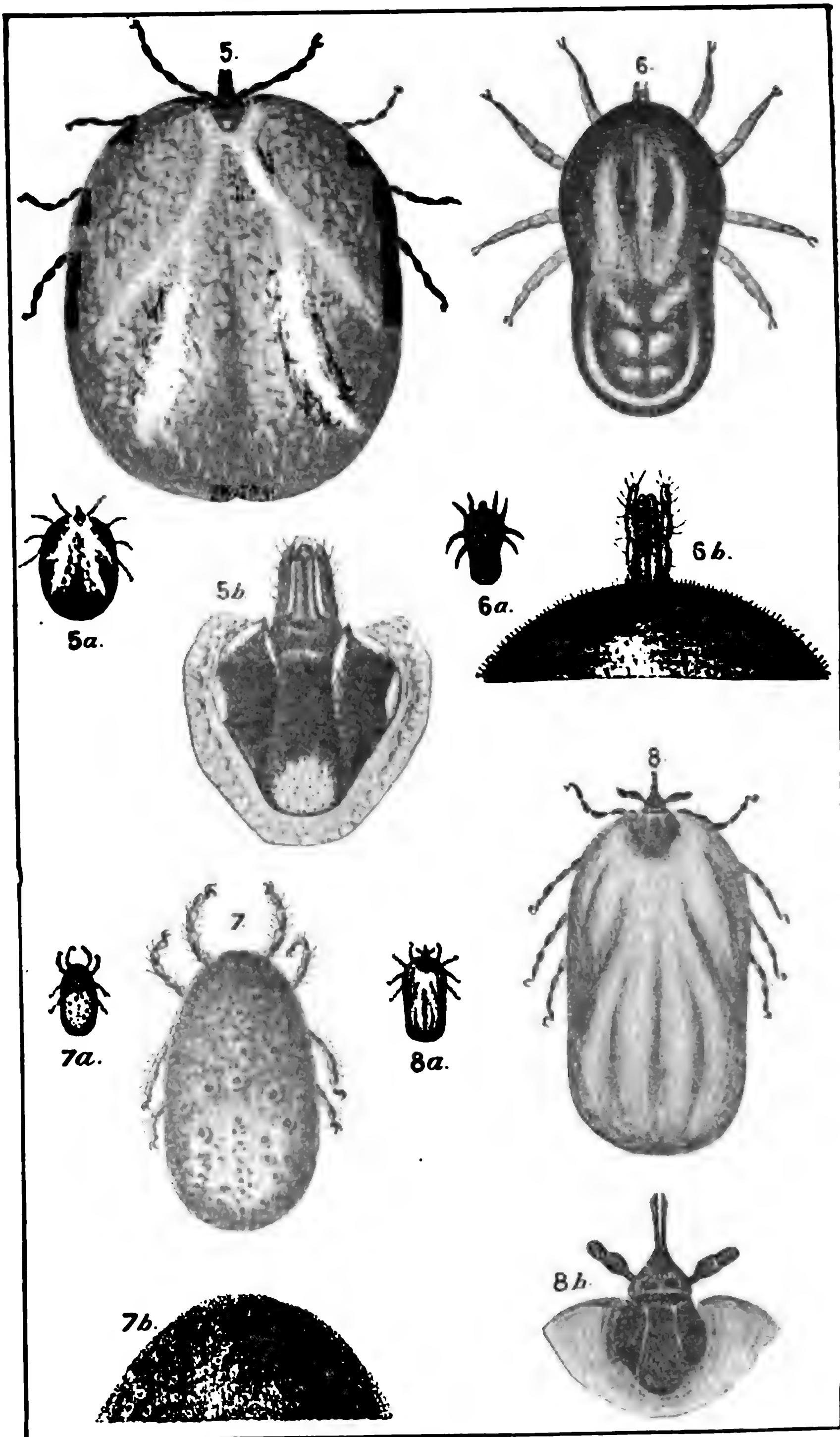


FIG. 4.—Various ticks that infect cattle

colored legs. The skin is wrinkled and contains very short and minute hairs. On the top as well as the bottom of the tick are numerous bright pits or cavities with raised borders (fig. 4, Nos. 7 and 7a). These vary in size, are arranged in rows radiating from the center more or less uniformly, and are usually symmetrical on each side. It is about three-eighths inch in size when mature. The head is so completely covered by the body that it can not be seen from the back (No. 7b). This tick has been observed on cattle once only, but is frequently found on chickens, turkeys, and other birds in the South.

EUROPEAN DOG TICK (*Ixodes hexagonus*).—The body of this tick is oval in shape and of an ashy color (fig. 4, Nos. 8 and 8a). The grooves on the back are united in an arch in front and diverge in the posterior portion of the body. The four pairs of legs are longer, thicker, and stronger than those of the cattle tick. The head and shield are brown-red in color and similar in shape to those of the catsor-bean tick, but less oval and rather more lozenge-shaped, with more acute lateral angles and narrower posterior angle (No. 8a). The palpi, or feelers, are longer and more prominent than in the cattle tick, but not so long as in the castor-bean tick. This dog tick has been collected from dogs, cattle, sheep, foxes, rabbits, squirrels, gophers, cats, birds, man, and other hosts in eastern United States.

LIFE HISTORY AS OBSERVED IN ALABAMA.

The following cattle tick records were made by Mr. W. M. Lewallen, while a student at Auburn, Ala., from August, 1905, to August, 1906. The fall of 1905 was dry, the winter was average with alternate periods of cold and warm weather. The spring of 1906 was early and average in moist and dry spells, and the summer was hot and wet.

Out of 20 ticks that began to lay from August 11 to 19 the number of days between laying and hatching were as follows: 30, 29, 23, 24, 23, 23, 23, 24, 25, 25, 25, 25, 25, 25, 25, 26, 27, 27, 25 days—an average of 25 days.

The ticks were all dead as follows: 35, 35, 35, 35, 35, 35, 35, 36, 35 days, an average of about 35 days and including the progeny of half the ticks. Of the other half after 35 days the progeny of two ticks were all alive and active, and after 35 days the progeny of the remaining ticks were nearly all dead.

In another lot of four ticks that began to lay September 19 to 21, hatching began after 40, 48, 42, and 46 days or an average of about 45 days. After 122 days and 228 days the progency of two ticks were all dead. After 63 days the progeny of one tick were alive, but inactive.

Tick Egg-Laying Record for 1905-1906.

Dates	Days	Eggs-Laid
From Oct. 31, 1905 to Feb. 12, 1906	104	3016
From Nov. 27, 1905 to Feb. 12, 1906	97	1632
From Jan. 21, 1906 to Mar. 15, 1906	53	1141
From Jan. 22, 1906 to Apr. 6, 1906	74	1487
From Jan. 22, 1906 to Mar. 19, 1906	56	1694
From Jan. 21, 1906 to Apr. 23, 1906	92	3840
From Jan. 21, 1906 to Apr. 19, 1906	88	3101
From Jan. 21, 1906 to Apr. 23, 1906	92	2840
From Feb. 15, 1906 to Apr. 6, 1906	50	1013
From Mar. 3, 1906 to May 3, 1906	61	2981
From Feb. 12, 1906 to Apr. 26, 1906	73	3586
From Feb. 23, 1906 to Apr. 28, 1906	65	2388
From Apr. 5, 1906 to Apr. 28, 1906	23	3687
From Apr. 7, 1906 to Apr. 26, 1906	19	2987
From Apr. 5, 1906 to Apr. 30, 1906	25	3210
From Apr. 5, 1906 to Apr. 27, 1906	22	1858
From Apr. 6, 1906 to May 1, 1906	25	2724
From Apr. 3, 1906 to May 1, 1906	28	3132
From Apr. 6, 1906 to Apr. 8, 1906	2	137
From Apr. 3, 1906 to May 1, 1906	28	3003
From Apr. 15, 1906 to May 5, 1906	20	1446
From Apr. 3, 1906 to May 2, 1906	29	2175
From Apr. 23, 1906 to May 9, 1906	16	3496
From Apr. 23, 1906 to May 18, 1906	25	2862
From Apr. 25, 1906 to May 7, 1906	12	1372
From Apr. 26, 1906 to May 7, 1906	11	345
From Apr. 26, 1906 to May 2, 1906	6	164
From May 21, 1906 to June 14, 1906	24	2687
From May 21, 1906 to June 4, 1906	14	1940
From June 18, 1906 to July 8, 1906	20	4261
From June 18, 1906 to July 4, 1906	14	4191
From July 16, 1906 to Aug. 8, 1906	23	3475
From July 16, 1906 to Aug. 12, 1906	27	3947

Monthly Average Egg Record for 1905-1906.

First Egg Laid	No Ticks	Last Egg Laid	Average No. Days	Average No. Eggs
From Oct. 31, 1906	2	Feb. 12, 1905	100	2324
From Jan. 21, 1906	6	Apr. 19, 1906	76	2350
From Feb. 12, 1606	4	May 3, 1906	62	2492
From Apr. 3, 1905	10	May 2, 1906	22	2435
From Apr. 23, 1906	5	May 18, 1906	14	1648
From May 21, 1906	2	June 14, 1906	19	2313
From June 18, 1906	2	July 8, 1906	17	4176
From June 16, 1906	2	Aug. 12, 1906	25	3711

Tick Record on Horned Jersey Calf, Texas Ticks

Oct. 15. 1905 Infested with 15 ticks.
Oct. 19 or 20. Moulted first time.
Oct. 21 or 22. Dark brown color; size of pin head
Oct. 28 or 29. Moulted second time, grew slowly up till this time. Ticks were brushed off (?) calf at this time before maturing.

On Hornless Jersey.

Nov. 15. Infested with 15 ticks.
Nov. 18. Ticks found on inside of thigh.
Nov. 20. Ticks lead white.
Nov. 21. Ticks darker, nearly brown.
Nov. 24. (1) Tick has reddish thorax, abdomen color of oxide of lead.
(2) Other ticks are milk white in color.
Nov. 27. (2) Tick has yellowishstripe on back.
Nov. 28. (1) Tick has yellowish specks on back.
Nov. 30. (2) Tick moulted. (1) Tick has yellowish spots on back.
Dec. 1. (2) Tick became dislodged leaving his moult on cow
(1) Tick moulted.
Dec. 5. (3) Tick found.
Dec. 6. (3) Tick dislodged. Ticks cannot be found.

Jersey Calf Below Barn.

Nov. 15. Infested with 15 ticks.
Nov. 20. Ticks lead white.
Nov. 28. Ticks grew larger.
Nov. 30. (1) Tick has yellowish stripe on back.
Dec. 1. 1, 2, 3, 4 appear about ready to moult; (5) tick has moulted.
Dec. 2. (2) Tick moulted (3) Tick has white speck on belly.
Dec. 3. 1, 3, 4 Ticks moulted

Dec. 6.	(4) Tick has tick beneath it (male?) about ½ its size.
	(5) Tick missing.
Dec. 9.	One female tick has two small male ticks beneath her; when she was lifted they seemed to be attached to her and on separation a little blood was present at the attachment. Female lead color, males brown.
Dec. 9.	Another female like the above with only one male
	Males don't increase in size while females. grow rapidly.
Dec. 13.	Dropped off of calf.
	Total no of days on calf 28
	One tick moulted in 15 days (2nd moulting). Others in 16 and 17 days.
	Red Spotted Calf
Dec. 15.	Infected calf with 15 ticks. Auburn ticks.
Dec. 19.	(1) Tick found, lead color.
Dec. 21.	1. Moulted and changed position.
Dec. 25.	2. Tick discovered, has white speck on abdomen
Dec. 31.	1. Tick of white cast, about size of pin head.
	2. Tick in process of moulting. Seems to have loose skin.
Jan. 1. 06	2. Tick has mark on back. 1. Tick whitish skin on belly.
Jan. 3.	Removed moult from both ticks, about size of tack head, dark brown.
Jan. 5.	2. Tick disappeared, Removed moult from tick 3. Tick 4. getting ready to moult. Tick 5. much smaller.
Jan. 6.	3. Tick moulted again. larger than yesterday.
Jan. 7.	6. Tick has one beneath it when discovered to-day.
Jan. 8.	6. Tick has no tick beneath it
Jan. 10.	4, 6&7, have males beneath them; females 6&7 about four times size of males with partial moult on posterior half of body.
	5. Tick moulted.
Jan. 12.	6&7 detached; 7. grown yesterday; 6. removed to-day.
	5. Tick has yellowish marking on back, males of 6&7 still attached.
Jan. 13.	5. Tick changed location; 4. Tick removed moult; males of 6&7 have disappeared, leaving bloody seat. Found 2 females on abdomen about grown, removed them. 3. Tick moulted.
Jan. 14.	4. Tick light brown, male left it, not ready for fertilization as she moulted after male sought her.

3. Tick has 2 males beneath her.

Jan. 16. 4. Tick had a male beneath her. Only one male under tick 3.

Jan. 18. 3. Tick engorged removed for breeding male left on calf.

Jan. 19. Male of tick 3 gone.

Jan. 23. 4, Tick engorged removed.

Jan. 24. Found two more engorged females, left them to see how long they remain.

Jan. 25. Two ticks found yesterday have dropped. Another found but disappeared.

Tick 4 engorged in 39 days removed by hand.

Tick 3 engorged in 34 days removed by hand.

Tick 1 moulted in 6 days.

Removed moult from 1&2 in 19 days.

Removed moult from 3 in 21 days.

Tick 5 moulted in 26 days.

Jersey with Horns.

Jan. 15. Infested with 15 ticks.

Jan. 16. 1 tick found.

Jan. 19. 1 tick again found, white spot on posterior part, probably moulted 18th.

Jan. 27. No ticks found from 19 to 27.

Jan. 30. Found a tick size of pin head, lead color.

Feb. 2. Tick oval shape, has yellow stripes on back.

Feb. 4. Tick moulted.

Feb. 9. Dark brown color.

Feb, 13. Tick mated.

Feb. 13. 2 ticks found ready to begin 2nd moulting.

Feb. 14. 1. tick dislodged.

Feb. 15. Male of 1 tick still attached.

Feb. 16. Male of 1 tick gone, 2 tick moulted.

Feb. 29. 2 tick dislodged.

Mar. 8. 2 tick couldn't be found.

Ticks collected on Jauuary 15 began to deposit eggs March 12 and continued during a period on an average of 40 days. Ticks collected on April 15 began to deposit eggs April 25 and continued during a period of an average of 17 days. The average length of life of ticks on cattle for late summer and early autumn was 22days for three tests. Longevity of larvae during the late fall and winter was six months and during the summer and autum thirteen days. The average length of parasitic period for five ticks during the latter part of summer, autumn, winter and early spring was twenty-nine days, the longer period prevailing in winter.

The following records were made by C. T Butler, while a student assistant in the Veterinary Department, during 1906 and 1907.

Bottle No.	Date Laid	Date Hatched	Percent Hatched (Approximate)	When dead and Remarks
All	Aug. 20-Sept. 20,'06	Began Sept. 19, '06		One bottle dead Oct. 15; another Oct. 20, due to lack of moisture (?). In the other bottles many ticks dead Mar. 20, 1907. Ticks dead in all but one bottle Mar. 28; in this boltie about half dead. Apr. 3, few ticks alive, but dead Apr. 10, 1907.
1	Sept. 20-Oct. 4, '06	Nov. 19-22, 1906	100	All dead but few Mar. 28; dead Apr. 1, 1907.
2	Sept. 20-Oct. 5, '06	Nov. 19-22, 1906	100	Many dead Mar. 28; all dead May 5, 1907.
3	Sept. 20-Oct. 27, '06	Nov. 19-22, 1906	100	All dead Mar. 28, (lack of moisture) (?)
4	Sept. 20-Oct. 29, '06	Nov. 15-22, 1906	100	All dead but few Mar. 28, '07. All dead Apr. 1, 1907.
5	Sept. 20-Oct. 1, '06	Nov. 19-22, 1906	100	All dead Mar. 28; due to lack of moisture (?).
1	Oct. 22-Nov. 22. '06	Began 3-10, 1907	10 to 20	Few ticks dead Apr. 12,'07
2	Oct. 22-Nov. 58, '06	Began 3-10, 1907	10 to 20	Few ticks dead Apr. 12,'07
3	Oct. 23-Nov. 9, '06	Began 3-5, 1907	5 to 10	4 to 10 ticks living Apr. 28, most of ticks died soon after hatching.
4	Oct. 22-Nov. 12, '06	Began 3-5, 1907	10 to 20	4 to 10 ticks living Apr. 29, dead May 22, most died early.
5	Oct. 22-Nov. 12, '06	Began 3-5, 1907	10 to 20	More than half dead Apr. 29, 1907.
1	Nov. 22-Dec. 18, '06	Began 4-3, 1907	1 to 5	Most of Eggs shrivled; few dead Apr. 29.
2	Nov. 21-Dec. 18, ,06	Did not hatch	0	Possibly too much light.
3	Nov 21-Jan. 16, '07	Began 4-3, 1907	not over 5	Few dead May 23.
4	Nov. 22-Dec. 18, '06	Began 4-3, 1907	5 to 10	Few dead Apr. 29.
5	Nov. 24-Dec. 18, '06	Began 4-3, 1907	10 to 15	Nearly all dead May 23.
1	Jan. 7-Feb, 5. '07	2 hatched Apr. 29	0	Egg shriveled.
1	Jan. 18-Mar. 5, '07		0	Eggs shriveled
2	Jan. 19-Mar. 26, '07		0	Probably due to too much light.
3	Jan. 19-Mar. 2, '07	1 tick but dead		
1	Mar. 2-25, 1907	May 10-23	30 to 50	
2	Mar. 3-26, 1907	May 6-23	70 to 90	
3	Mar. 4-30, 1907	May 10-23	30 to 40	
4	Mar. 5-26, 1907	May 10-23	40 to 60	
5	Mar. 5-25, 1907	May 6-23	80 to 90	
1	Mar. 22-Apr. 1, '07	May 22		
2	Mar. 23-Apr. 26, '07			
	Mar. 27-Apr. 9, '07			

Of the ticks that hatched Nov. 1906, bottle 2 lived until May 1907, others died some time before probably due to lack of moisture.

The probable reason for eggs (laid between Oct. and Mar.) being shriveled is too much light. Direct rays of the sun was sometimes on them, for 2 hours per day.

Summary of Butler's Tick Records.

Aug. 20.-Sept. 10. 6 ticks laid from 305-3,456 eggs.......Ave 1,623
Laying period from 18-22 days..................Ave. 20 days
Sept. 20-Oct. 5. 5 ticks laid from 1,056-2,243 eggs......Ave. 1,520
Laying period from 8-10 days.................Ave. 12 days
Oct. 22-Nov. 28. 5 ticks laid from 1,125-2,646 eggs......Ave. 1,703
Laying period from 18-37 days..................Ave. 25 days
Nov. 21-Jan. 16. 5 ticks laid from 2,235-2,937 eggs......Ave. 2,599
Laying period from 27-56......................Ave. 33 days
Jan. [illegible]-Feb. 5. 1 tick laid 1,978 eggs 1,978
Laying period, 29 days...............................29 days
Jan. 18-Mar. 5. 3 ticks laid 833-1,721 eggs..............Ave. 1,192
Laying period, from 26-46 days..................Ave. 39 days
Mar. 2-30. 5 ticks laid 1,419-3,413 eggs................Ave. 2,414
Laying period, 23-28 days......................Ave. 24 days
Mar. 22-Apr. 26. 3 ticks laid from 340-3,745 eggs........Ave. 1,371
Laying period from 9-34 days...................Ave. 20 days
N. B.—Tick 3 was only half-grown eggs; did not hatch.
Apr. 25-May 20. 5 ticks laid from 1,143-3,703 eggs.......Ave. 2,656
Laying period from 8-25 days..................Ave. 20 days

Summary of Non-Parasitic Life of Tick

Egg-laying period	Average no days	Hatching period	Longevity of Seed Tick
Aug. 20-Sept. 10	20	30 days	A few lived 190 days
Sept. 20-Oct. 5	12	29 days	Few lived for 129 days
Oct. 21-Nov. 28	25	131 days	Few lived for 50 days
Nov. 21-Jan. 16	33	131 days	All dead in 58 days
Jan. 18-Mch. 5	39	no hatching	
Mch. 2-Mch 30	24	64 days	No record
Mch. 22-Apr. 26	20	60 days	No record
Apr. 25-May 20	20		

The winter of 1906 and 1907 was exceptionally warm. The mature laying ticks, eggs and seed ticks were kept in a room with window open and no fire in the room. The seed ticks and eggs were kept in test tubes with moist cotton in the lower part of the tubes.

Why Eradicate the Cattle Tick.

The cattle tick lives by drawing the blood from its host, and the host is usually cattle. When undisturbed, the ticks in a pasture get so numerous that they take sufficient blood from the cattle in the pasture, to reduce or retard the growth of the cattle, or check milk or beef production. I have seen cattle go into a tick infested pasture in fairly good condition in the spring and owing to loss of blood by ticks and the tick fever, the cattle came out of the pasture in the fall weighing less and consequently much poorer than when they went into said pasture, and the pasture a good one so far as the grass and water supply were concerned.

Tick fever kills more native cattle in the tick infested areas than all other cattle diseases in the South. Moreover, the cattle tick prevents free trade in the markets of the United States and of the world for the greater part of the year. Consequently, it decreases the market price of southern fed and southern bred cattle from one-fourth to one-half a cent per pound in the cattle markets above the quarantine line.

The losses from death of northern cattle and imported cattle brought into the South have been so great that improvement in the various dairy and beef breeds represented in the South and the introduction of new breeds of cattle have been seriously hindered and checked.

The following tabulated statement will give an approximate idea of the various losses falling upon the tick infested area of the South:

Number and Value of Farm Animals in Alabama Jan. 1, 1906.

Animals	No.	Farm Value	Total Value of Each Kind	Total Value of all Animals in Ala.. Jan. 1,1906
Cows	253,132	$ 20 40	$ 5,163,893	
Other cattle	496,762	8 32	4,131,822	
Horses	155,142	93 69	14,535,227	
Mules	185,839	111 66	20,750,794	
Swine	1,137,501	4 65	5,289,380	
Sheep	195,597	2 10	409,776	
				$50,280,892

In the United States Jan. 1, 1906, there were about 67,000,000 cattle. In the entire quarantined area there were about 15,000,000 cattle. In Alabama at the same time there were 749,894 cattle. Losses coming directly and indirectly from the cattle tick:

1. Decrease from milk production in five million milk cows, one million of which is giving milk all the year. Each cow in milk losing one quart of milk per day and rating that at four cents per quart on the farm. 1,000,000 x .04 equals $40,000 per day. $40,000 x 365 gives the loss per year........$14,600,000
2. Loss in the decreased or checked or retarded growth in the other 14,000,000 cattle at $1 per head........ 14,000,000
3. Loss of at least $3 per head on all cattle from the South sold above the quarantine line—700,000 cattle at $3 each........ 2,100,000
4. Loss by death from tick fever of 700,000 native cattle each year, valued at $15 per head........ 10,500,000
5. Loss by tick fever of breeding cattle shipped from the North into the South........ 50,000
6. Cost of the United States and the various quarantined States in maintaining quarantined lines and eradicating the tick...... 200,000

Total annual loss from the cattle tick in the quarantined area........$41,450,000

Alabama loses each year about one-twentieth of this total or about $2,000,000. The total live stock valuation

for Alabama is $50,280,892. Hence, the cattle ticks in Alabama produce a loss of 4 per cent. each year on the amount or capital invested in live stock.

METHODS OF ERADICATING CATTLE TICKS.

I. Cleaning Cattle.

1. By applying oils to the cattle. This may be employed by using hand cloths or swabs, by spray pumps or by dipping the cattle in a vat or in a dipping tank. The oils that can be used are more or less variable. Beaumont crude petroleum, West Virginia or Kentucky Black oil, cotton seed oil, lard, machine oil, etc., have been employed. Kerosene oil (20 to 25 per cent.) emulsion or kerosene oil (20 to 25 per cent.) in combination with cotton seed oil or with lard have been used. One to two per cent. of sulphur may be added to any of the above oils except Beaumont oil or black oil. The essential things in the use of oils or grease in killing ticks on cattle is to be certain to apply it all over the cattle. If many cattle are to be treated use a spray pump or a dipping tank. (a) If a few cattle are to be greased, a good piece of sacking burlap or cotton bagging may be employed by hand or on a swab stick. Have the animal put into a specially prepared break or chute. Two men (one working on each side of an animal) can grease five to ten cattle in an hour. (b) A spray pump, costing five to fifteen dollars, is very convenient. The bucket spray pump is the cheapest. But the knapsack and the barrel spray pump are very handy. These pumps are the same as horticulturists use in spraying fruit trees. It is well to have a kerosene mechanical mixer attached to pump. With it you can use water or kerosene with the oil. This pump will mix twenty-five per cent. of Beaumont oil with the water and effectually cover the cattle with very little loss of oil. The water possesses no advantage except to spread the oil in thinner layers, to make it go farther and waste less. A quart of Beaumont oil will effectually cover a 700 pound cow with this mechanical mixer spray pump;

while it will take two to four quarts to cover the same cow in putting it on with a hand rag or swab or by immersing her in a dipping vat filled with oil. Two sprayers, one working on each side of the animal, will spray one to two hundred cattle in a day. (c) Oil in the dipping tank or vat is rather expensive. But is is sometimes employed in that way—especially by the Federal government and by the large ranch owners in Texas. In order to fill a 2,000 gallon dipping tank it would take a half car load of Beaumont oil. Some have tried it by having about six inches of oil floating on water in the tank. This has not in all cases proven successful. The Beaumont oil may be used in the tank in a 25 per cent. soap emulsion.

Oil has some striking advantages. It destroys ticks, it stays on the hair and skin for several days, it keeps off flies. It prevents skin evaporation and consequently may raise the animal's temperature; to avoid this danger have plenty of shade and water for the cattle for one or two days after oiling them.

2. An arsenical dip has been employed successfully in Cuba, Texas and in one instance in Alabama. Dr. N. S. Mayo, chief veterinarian of Cuba, first used this formula and directions for making it are as follows:

Arsenic trioxid, commercial	8 pounds.
Sodium carbonate, crystalized	24 pounds.
Yellow soap	24 pounds.
Pine tar	1 gallon.
Water sufficient to make	500 gallons.

Dissolve the arsenic in 20 to 30 gallons of water by boiling 30 to 40 minutes. Add water to make 100 gallons. Dissolve the soda in 20 to 30 gallons of water; dissolve the soap (shaved) in the soda solution; pour the tar into this in a fine stream, stirring at the same time. Mix the two solutions. Add enough water to make 500 gallons.

Dr. John W. Parker, of Texas, made it by leaving out the soap, according to the following formula:

Arsenic	8 pounds.
Sodium Carbonate	24 pounds.
Tar	1 gallon.
Water sufficient to make	500 gallons.

This is made in the same way as given in the directions for preparing Dr. Mayo's dip except the soap is omitted. It is best to use free-stone or rain water in making this dip, also exercise great care in having the ingredients accurately weighed and measured.

The cattle should not be held over one minute in the tank. In fact, it is best not to hold the animal in the tank but let it pass at once through and out of the tank to the dripping pen. From the dripping pen let the animal pass into a bare lot or place containing shade and no grass or feed and remain there till dry.

To dispose of the waste or unused part of the dip, care must be taken. Dig a deep pit in some out of the way place where it will not seep into a well. Put the old unused or waste dip into this pit and cover it with plenty of soil. Remember this dip is poisonous. When through dipping, mark the height of the dip in the tank, then if some of the water evaporates before the dip is used again sufficient water may be added to fill the tank up to mark. Or cover the tank when not in use with close fitting lids or cloth to prevent evaporation and filling with rain water. As a rule it is uncertain and often unsafe to use old arsenical dip. Better carefully dispose of the old dip and prepare a new lot just before using it.

This arsenical dip may be used with a spray pump or by a hand swab. Keep your hands greased with lard or vasaline to prevent the arsenic from injuring the skin, or keep your hands out of the arsenical dip.

3. Cresol dips or coal tar dips or insecticides may be employed by hand or in spray pump or in vat. But many of them are so inconstant in strength that one can not always depend upon them for efficient work. I have known

some that were said to kill ticks when used at a strength of 5 per cent. and a trial proved that a 10 per cent. solution was required to do effective work.

4. Picking cattle ticks from cattle may be employed where one or even a dozen dairy cows are stabled twice a day. The big ticks may be hand picked, or rubbed off with stiff brush or curry comb. The ticks that are picked or brushed off should be given to chickens or otherwise destroyed to prevent them from laying eggs and producing more seed ticks. This must be done once every day. Chickens about a cow lot or yard will pick up all the ticks that drop off and pick a large number of ticks directly from the cattle. Begin this picking early in the spring, because every tick killed in the spring means the cutting off of the seed that will multiply into the thousands in the summer and fall. Another good time to begin picking ticks is September 1, and keep it up until January 1 or until ticks disappear, then keep a good keen eye for ticks again the next spring. In fact picking off the big ticks when oiling or applying any tickicide is wise because some half grown and some mature ticks may escape the oil or the other material; fall to the ground and lay eggs.

Feeding sulphur to cattle will not kill the ticks on the cattle or prevent seed ticks from getting on the cattle. The United States Bureau of Animal Industry and other investigators have thoroughly tested the feeding of sulphur to cattle and proven it to be of no value.

Cleaning Cattle of Ticks Without the Use of Tickicides by Morgans Feed Lot Method, or the Pasture Rotation Method.

1. The feed lot method was first employed by Morgan. In this the cattle are placed in a feeding pen that has been constructed on tick free ground (plowed ground, cotton or corn or sweet potato ground or any place where cattle have not been penned or left for six months or more, is free of cattle ticks). Keep the ticky cattle in this feed

lot for twenty days—say begin May 1 or any time in spring, summer or fall. At the end of twenty days move move the cattle into another cattle-tight feed pen on tick free ground; pen number two should be at least ten feet away from th first pen; keep the cattle all the time in pen number two, for twenty days, and then move them into pen number three of the same kind. As a rule when the cattle move from pen number two into pen number three, the cattle will be entirely free of ticks, no matter how many they had on them in the beginning or when they went into pen number one. This is explained by the life history of the cattle tick. All female ticks when engorged with blood drop off the cattle, hide and soon begin to lay eggs. The tick eggs can not be deposited by the old female tick and then hatch under twenty days. Hence, before any tick eggs hatch or before the appearance of seed ticks in pen number one, the cattle are moved into pen number two. The same is true in pen number two. By the end of forty days in spring, summer or fall all of the female ticks have developed or become mature and have dropped off the cattle. What becomes of the males? They do not count because they can not lay eggs and will not work for their own living. It is always best to keep the cattle in pen number three for ten to twenty days before moving them into tick free areas. This feed lot method of cleaning cattle of ticks is expensive because three pens must be built, the cattle fed and watered in the pens for fifty or sixty days. The expense could be reduced to a minimum by preparing good forage crops like kaffir corn, sorghum, cowpeas, soja beans, and corn thick in the row. Have the crops come so that the cattle can be fed green soiling forage throughout the fifty days. In order to make the water supply cheap build the first pen on the lower part of a small running branch where there are no ticks, build pen number two ten feet or more above it and pen number three ten or more feet above pen number two.

It will be cheaper to apply Beaumont oil thoroughly and

keep the cattle in a tick free pen where they can have good shade and plenty of water and feed for four days, then apply the oil thoroughly again and keep them in shady pen for three or four days more, and they will then be clean or free of cattle ticks, and ready to be turned into a tick free pasture or field.

2. Pastures or fields that are tick free may be used in the same way. Take a hay field of Johnson grass or red clover, or mellilotus, or of crab grass, or of any other forage or grass, divide it into three pastures or move the temporary partition fences every twenty days.

3. Where there are only one to five cattle, they can be staked and cleaned. Always begin at the lower part of the branch and stake the cattle so as to move the stake up the ditch or branch every day. Where the cattle were staked the first twenty to forty days, do not stake there again for three or four months.

When Should the Tick Killing Materials be Used.

If an effective or tick killing material is applied at first in the fall (beginning September or October 1st), and it is thoroughly applied once per week until December 1st or until frost appears; and during the winter as often as ticks are found; then keep up the thorough applications once per week from March until May, June or July 1—all the cattle ticks will be killed in the pasture and on the cattle. One thorough application of a good oil will usually kill all the ticks on the cattle, but as soon as the oil is rubbed or washed off the cattle will pick up other seed ticks in the infected pasture or lots. Applying the oil or other material once per week and sometimes once every two weeks will eradicate the ticks in a pasture because as fast as the ticks mature they are killed. Hence, if the mature ticks are all killed for four months in summer and six to eight months in winter all the tick eggs will have perished or hatched into seed ticks and the seed ticks will all have died from starvation or will have been killed on the cattle. This method

admits of beginning in the early spring or early fall,—say from March to December or from September to June. It is most effectual in good pastures where the cattle are confined during the spring, summer and fall in a fixed enclosure. Upon the ranges it is difficult to make it effectual because one or more cattle owners will often fail to regularly and thoroughly apply the tickicide.

II. Cleaning Pastures and Tick Infested Fields or Ranges.

1. Keep all cattle, horses and mules off of a given pasture, field or range four months in summer or six to eight months in winter and all the tick eggs will have perished or hatched and all seed ticks will have starved to death. The seed tick lives only on the blood of cattle, horses or mules.

(a) May 1, divide your pasture into two parts with a cattle tight fence so that cattle can not put their heads through between the wires. If possible put a six inch board on the ground or throw up a ridge with a plow on the fence line before the fence is built. Keep the cattle, horses and mules out of the high part (No. 1) and in the lower part (No. 2) from May 1 to October 1. Then move the cattle to a tick-free pen, oil them thoroughly once and in four days oil them again. Now they can be put into pasture number 1 or allowed to run in the corn or cotton field or other tick-free field. Pasture number 2 must be kept closed from October to May or June. The cattle may go into pasture number 1 any time after October 1, providing they are free of ticks. Sometimes the cattle may be turned out of pasture number 2 October 1 or December 1 into the corn field or cotton field and other cultivated fields—(all of which are tick-free in the fall). The time for turning them out will depend upon when the fields are ready and when frosts have appeared. After frosts and cold weather have come the life cycle of ticks is much prolonged and usually by the middle or last of December cattle are free of ticks, and remain clean

all winter providing they are not kept in infected barns, sheds or lots where heating manure hatches out the eggs. Hence, if cattle are turned out of pasture number one October 1 and allowed to run in cultivated fields until March 1 or sometimes until April 1, they may be examined closely for ticks, and if found tick free, can be turned into pasture number two. If not tick free, they should be cleaned by oiling thoroughly before turning them into pasture number two.

(b) September 1 take the cattle, mules and horses out any given pasture, keep them out continuously until the next May 1, and see that the cattle, horses and mules are clean of ticks before returning them to the pasture. This method has been used for several years very successfully by Dr. Butler of North Carolina. When tick free pastures or fields are made, they will remain tick free as long as ticks are not carried into such areas on cattle, horses or mules. In some rare cases, seed ticks or old females may be washed down from higher elevations into a low pasture.

(c) Cultivating land destroys ticks. It is possible that one or two good cultivations of land in summer will make it tick free.

(d) Burning the grass, leaves and weeds in the fall or spring will destroy many ticks, but it will not make a pasture entirely free of ticks. As a rule it should not be advocated because it destroys young timber and burns up vegetable matter.

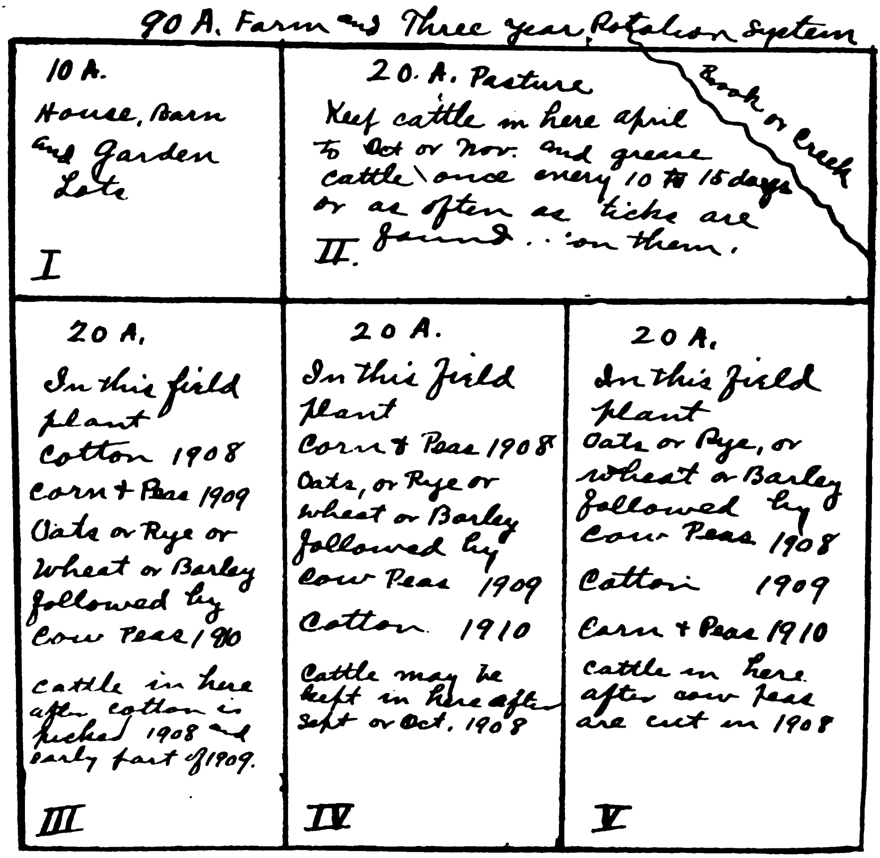
(e) Heavy, washing rains carry many of the eggs and seed ticks away.

(f) Some insects destroy many of the female ticks and tick eggs.

(g) Dry and hot, sunny places are hard on ticks—in fact seed ticks can not live one month in such places. Shade and a little moisture in hot weather favors the hatching of eggs and the longevity of the seed tick.

Rotation of Crops and Pastures Help Eradicate the Tick.

A few systems of rotation of crops are introduced into this bulletin to suggest ways by which concentrated feed, forage and hay can be produced in sufficient quantities on the farm to enable the farmer to handle his cattle and other live stock during the time of tick extermination with the least expense and trouble. The crop rotation systems are great aids to soil improvement and to the eradication or holding in check of cotton wilt or black root and other fungus diseases and insect pests. Moreover, rotation of crops means diversified farming and



forces the farmer to feed live stock on his farm or lose soil fertility by selling feed, forage and hay. Again, feeding live stock and growing legumes and other forage crops on the farm increases the vegetable matter or humus in the soil. Humus can not be bought in commercial fertilizers and the old worn lands are almost universally deficient in vegetable matter.

The rotation systems suggested are not iron clad, and may not be suitable to every farm. Yet the tick inspector and the farmer can study these and if they are not suitable as a whole or in part to a special farm, these will suggest others or methods of preparing a system adapted to the special farm.

In the ninety acre farm and three year rotation system, the plan adopted for eradicating the tick is oiling method with the cattle kept in the pasture from April until October or November or until they can be turned into the field where cow peas have been harvested or into the field where corn and peas have been removed, or into the cotton field after it has been picked. On this farm pasture II could be divided May 1, and either plan (a) or (b) of starving out the ticks and greasing the cattle only twice just previous to putting them into tick free areas could be employed. This three year rotation system was first suggested by Director Redding of Georgia.

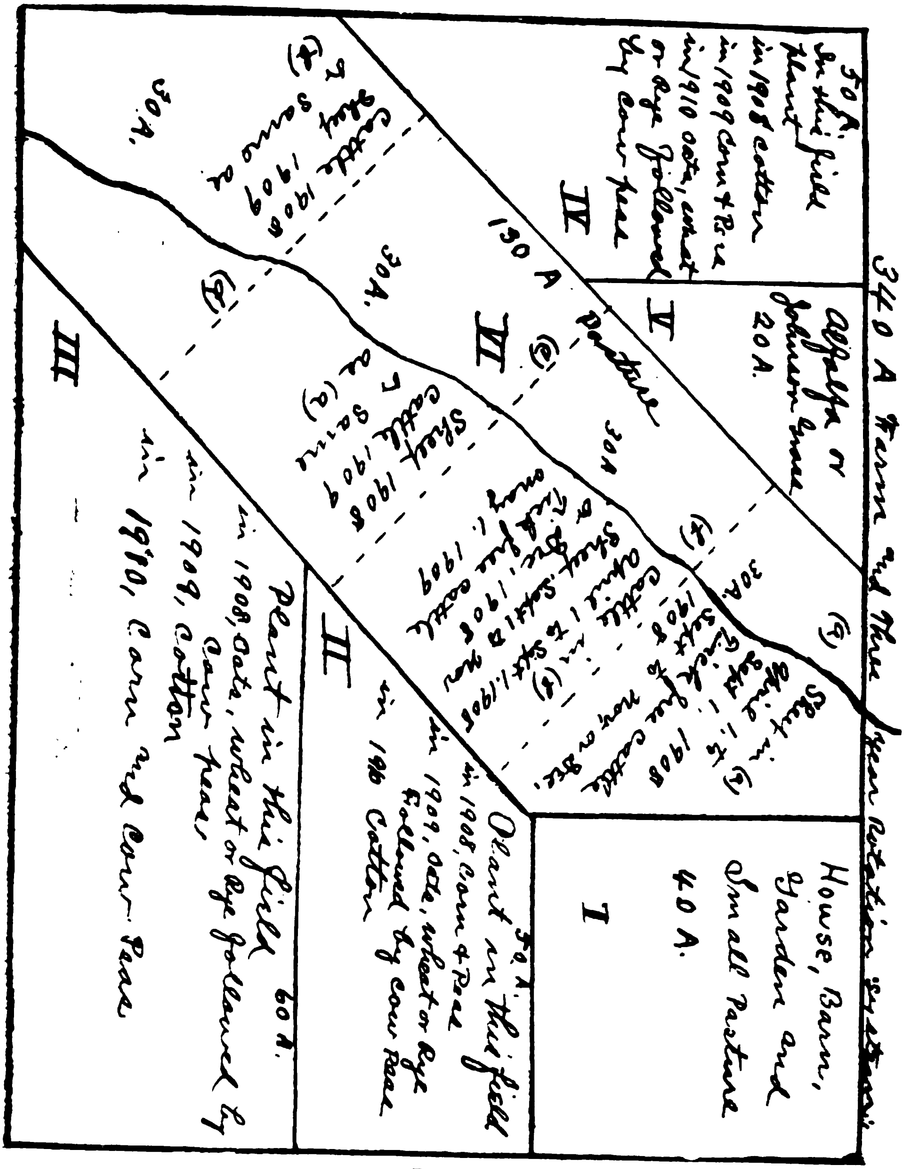

340 A Farm and Three year Rotation
50 A. In this field plant in 1908 cotton in 1909 Corn & Peas in 1910 Oats, wheat or Rye followed by Cow Peas
IV
Alfalfa or Johnson Grass 20 A.
V
130 A Pasture
VI
30 A.
House, Barn, Garden and Small Pasture 40 A.
I
50 A. Plant in this field in 1908, Corn & Peas in 1909, Oats, wheat or Rye followed by Cow Peas in 1910 Cotton
II
Plant in this field 60 A. in 1908, Oats, wheat or Rye followed by Cow Peas in 1909, Cotton in 1910, Corn and Cow Peas
III

FIG 6

The rotation system on the 340 acre farm is the same as on the 90 acre farm. But the methods employed in eradicating the tick are different. The pasture VI is divided into four parts. In (a) the sheep, goats, or hogs are kept from April 1 to September or Oct. 1, then they are removed to (b) and the cattle in (b) are cleaned by thoroughly oiling them twice, with four days between each oiling) or apply any other effective cattle dip twice; then after the cattle are kept for a few days in a tick free lot or pasture, they may be put into (a).

Or, the pasture might be divided into just two parts and the same plan employed. Instead of putting the cattle back into (a) they could go into the corn and pea field or into the cowpea field after those crops have been harvested, and after the cotton is out put the cattle into the cotton field. Keep them in the cultivated fields during the late fall and winter, and put them back into (a) in April. The cattle could not be moved into (b) before May or June 1.

It would not be advisable to try to grow alfalfa in part V unless the land was lime land or made sweet by sowing sufficient air slaked lime or ground lime rock on it. Nor would I advise planting Johnson grass on this land, but if it is already there, make the best of it by cutting it for hay always before it goes to seed.

Recent inevstigations indicate that sheep may be carriers of cattle ticks. Hence, it may be necessary to keep them out of pasture or other places where it is desirable to starve out cattle ticks.

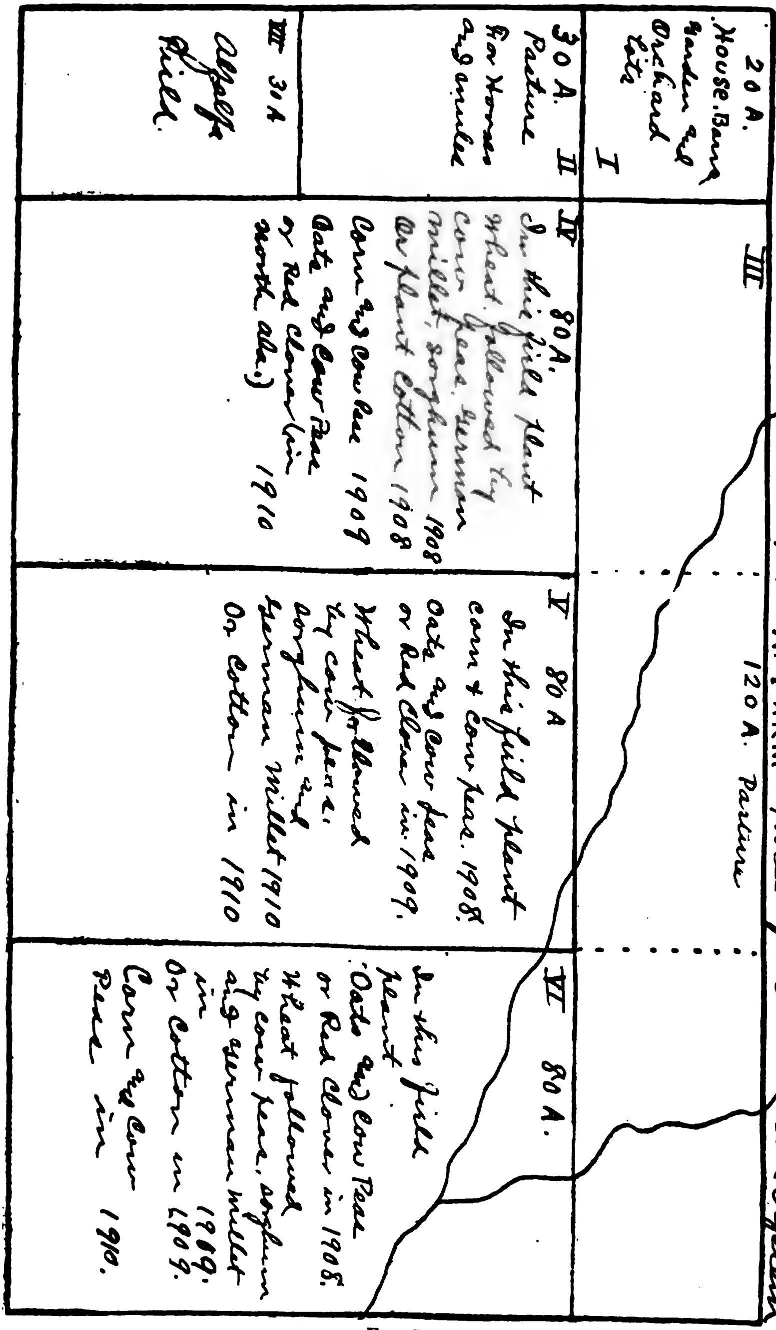

440 A. Farm Three year Rotation System
20 A. House, Barn, Garden and Orchard Lots
I
30 A. II
Pasture for Horses and mules
VII 30 A
Alfalfa field
III
120 A. Pasture
IV 80 A.
In this field plant wheat followed by cow peas, German millet, sorghum 1908
Or plant Cotton 1908
Corn and Cow Peas 1909
Oats and Cow Peas or Red Clover (in north also) 1910
V 80 A
In this field plant corn + cow peas 1908.
Oats and Cow peas or Red Clover in 1909.
Wheat followed by cow peas, sorghum and German millet 1910
Or Cotton in 1910
VI 80 A.
In this field plant Oats and Cow Peas or Red Clover in 1908.
Wheat followed by cow peas, sorghum and German millet in 1909.
Or Cotton in 1909.
Corn and Cow Peas in 1910.

FIG. 7.

The rotation system on the 440 acre farm is also a three year system and very much like those given for the 90 acre and the 340 acre farms. But in this cotton is replaced, optional or divided with wheat followed by one or more of the following: cow peas, German millet, sorghum or soja beans. The oat crop is to be followed by cow peas, but red clover or alsike clover might be sown with the oats. Red clover, of course, could be used only in North Alabama.

The 120 acre pasture could be used for cattle and the cattle regularly oiled, or the pasture divided into two parts, on May 1 move all cattle, horses and mules into the part next to the house and barn. Keep all cattle, horses and mules out of the other part until October 1, then the clean cattle can be put into it. Or take all cattle, horses and mules out of the pasture about September 1 and keep the entire pasture closed to cattle, horses and mules until May 1 the next year; then put only tick clean cattle into the pasture.

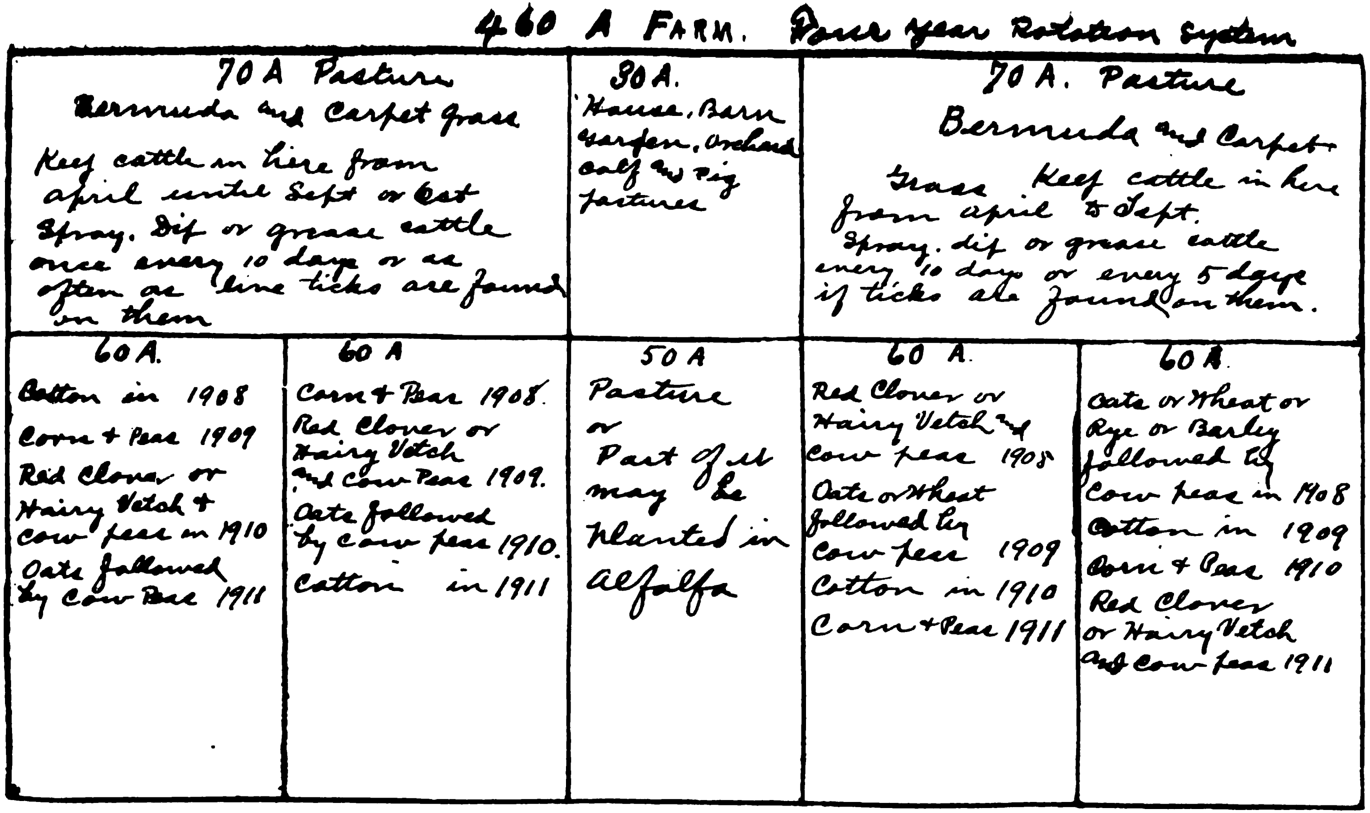

460 A FARM. Four year Rotation system
70 A Pasture
Bermuda and Carpet grass
Keep cattle in here from April until Sept or Oct
Spray. Dip or grease cattle once every 10 days or as often as live ticks are found on them
30 A.
House, Barn garden, Orchard calf and pig pastures
70 A. Pasture
Bermuda and Carpet Grass
Keep cattle in here from April to Sept.
Spray. dip or grease cattle every 10 days or every 5 days if ticks are found on them.
60 A.
Cotton in 1908
Corn + Peas 1909
Red Clover or Hairy Vetch + cow peas in 1910
Oats followed by Cow Peas 1911
60 A
Corn + Peas 1908.
Red Clover or Hairy Vetch and Cow Peas 1909.
Oats followed by cow peas 1910.
Cotton in 1911
50 A
Pasture
or
Part of it may be planted in Alfalfa
60 A.
Red Clover or Hairy Vetch and Cow peas 1908
Oats or Wheat followed by Cow peas 1909
Cotton in 1910
Corn + Peas 1911
60 A.
Oats or Wheat or Rye or Barley followed by Cow peas in 1908
Cotton in 1909
Corn + Peas 1910
Red Clover or Hairy Vetch and Cow peas 1911

FIG. 8.

The four-year rotation system given on the 460 acre farm plan is one that is intended for a farm where large quantities of forage or hay crops are desired for feeding live stock. Notice that the soil improving crops are very prominent. The cow peas after oats could be replaced by soja beans—especially after the land has been improved by the rotation system and the use of stable manure. On this farm are two 70 acre pastures and 150 acre pastures. To clean the cattle and the pastures of ticks, the oiling method may be adopted or either of the other methods can be used. With this number of pastures fenced and all of the separate cultivated fields fenced, it would be relatively easy to clean all the cattle and all the pastures. Keep all of the cattle in one of the 70 acre pastures from April 1 to Sept 1, then move them into the corn and peas or the cow pea field after they have been harvested; later put them into the cotton field, and then shift them about on the cultivated fields until April or May 1. At that time, if the cattle are not clean of ticks thoroughly oil them or dip them twice, with four days between each oiling or dipping and put them into the other 70 acre pacture, out of which they were moved September 1. Thus in one year all of the pastures and cattle can be readily cleaned of cattle ticks.

When a pasture is vacated by cattle May 1, the low, rich, open, bottom lands may be plowed in August or September and sowed in winter rye or barley. These will give green grazing in the winter varying in quantity according to the fertility of the land and the cold or warmth of the winter.

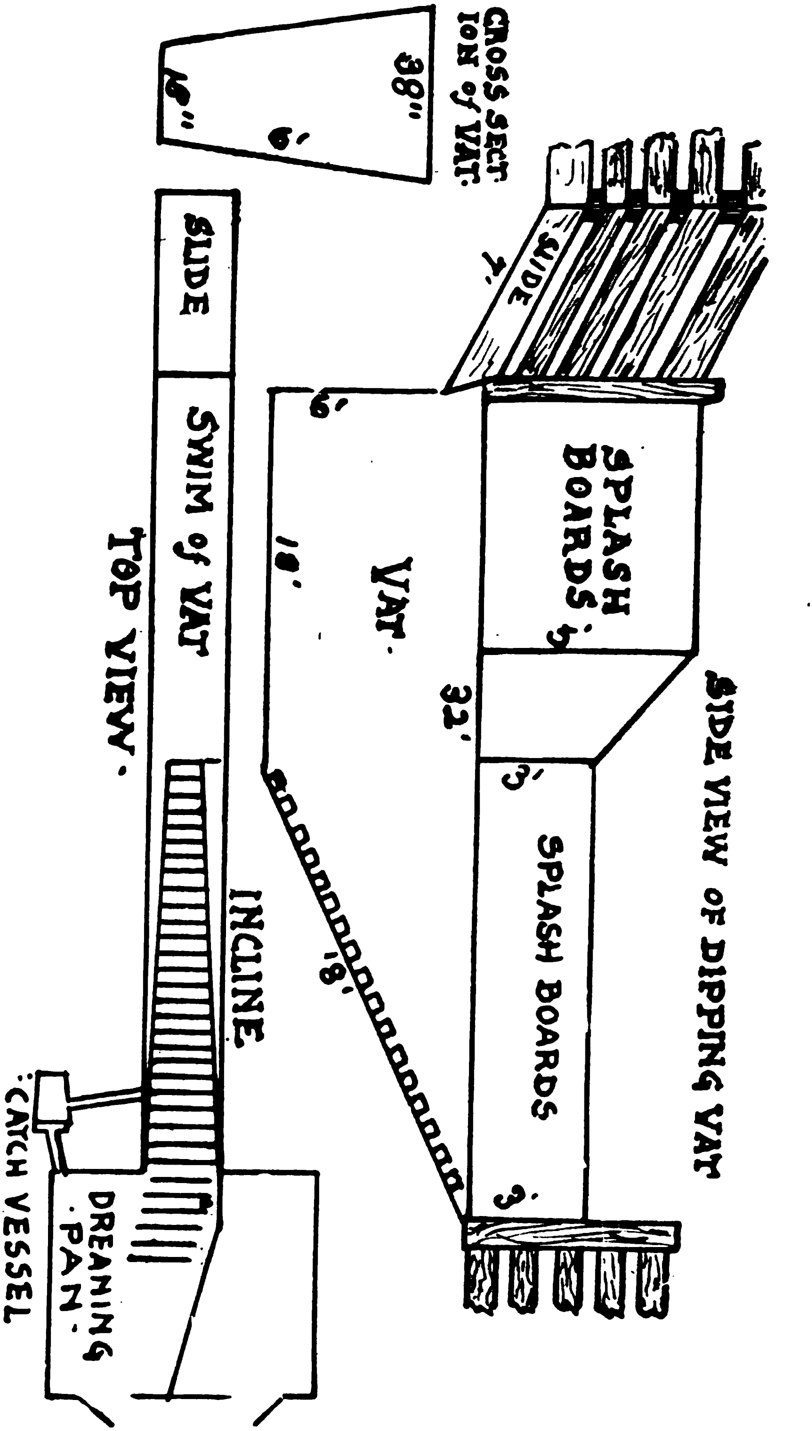

CROSS SECT ION of VAT
38"
6'
18"
SLIDE
SWIM of VAT
TOP VIEW
INCLINE
DREANING PAN
CATCH VESSEL
SLIDE
7'
SPLASH BOARDS
5'
VAT
6'
18'
32'
3'
SPLASH BOARDS
3'
18'
SIDE VIEW OF DIPPING VAT

FIG. 9.

How to Make the Vat.

Length of swim, 18 feet. Incline, 14 feet 1 in. "Slide," 7 to 8 ft., with drop of 3 ½ to 4 ft. Top width, 38 in. Bottom, 18 in. Depth, 6 ft. Set in ground 5 1-2 feet.

Frame with 2x4, every 16 to 18 inches.

Lay bottom of 2x18x18 ft. cypress. Then lay sides of 1x4 best flooring. Incline of 2x18x16 ft. cypress, cut in two pieces to fit, and dressed. Perpendicular end of same. "Slide" of good straight grained lumber, hardwood dressed, or soft wood covered with sheet-iron. It should be 7 feet long, with about a thirty degree slope. All joinings should be carefully fitted, and laid in coal tar or white lead. Quarter-round may be laid in angles to prevent leakage.

Dripping pen may be single or double. Should not drain into vat, but to one or both sides, where dip should be received into a suitable catch-vessel, through a screen, and allowed to settle before returning to vat, to get rid of filth. "Incline" and floor of dripping pen must be cleated.

A cover should be provided for the vat to prevent evaporation, which would concentrate the dip so that it would be of unknown strength and possibly unsafe to use. When not in use, drainage from dripping pen should be diverted from vat in case of rain, to prevent the dip in vat from being diluted.

Vat of the above measurements will require 2,000 gallons to fill 5½ feet deep. Dr. Parker, of Texas, wrote the specifications for this vat.

Bermuda.

Every permanent pasture in Alabama or the South should be set in Bermuda. All the upland and all the bottom lands that are not too wet are suitable places for it. The hill pasture lands should be terraced and set well in Bermuda. This will stop washing and hold fertility. The greatest mistake is made when one attempts to grow it on very poor, bare or washed land, without the use of fer-

tilizers. A complete commercial fertilizer, or stable manure will make it grow. When possible, it is always best to grow one or more crops of cow peas on the land after it has been terraced (if hill sides) and then plant in Bermuda. It is best to grow wheat, rye, barley, vetch or burr clover on the land in winter, between the times of growing the cow peas. These will act as catch crops, prevent the soil from washing and hold fertility. The best time to plant Bermuda roots or stems is during the wet weather in May, June or July. Dig up the Bermuda from a sodded place and be sure to avoid a place where nut grass or Johnson grass is growing. Also avoid carrying smut grass with the sod. The smut grass can be easily separated from the roots or stems of the Bermuda. Furrows may be opened from one to two feet apart and the Bermuda roots dropped into the furrows and covered with the plow. The Bermuda roots may be run through a corn cutter and then they will be more easily handled and will plant more ground. If the land is in corn, the Bermuda roots may be planted in the middles. This may prevent the corn from making a full crop, but with plenty of rain and fertile soil, it will make a good Bermuda sod. Burr clover or hairy vetch may be planted in the furrow with the Bermuda roots. The combination of Bermuda and burr clover will produce at least 10 months pasture in nearly every year. Bermuda on rich land will produce as much pasture as Kentucky blue grass will produce in Kentucky. Bermuda can be made to grow in the shade providing the soil is sufficiently fertile and the shade is not too dense. I have grown it under cedar trees, producing a solid sod. Its greatest enemies are smut grass and nut grass; and carpet grass will crowd it out of wet places. Japan clover is said to smother it some, but it will not do it only on poor land. In rich bottoms not too wet it will grow high enough to be cut for hay.

CARPET GRASS (PASPALUM PLATYCAULE).

This is also called blanket grass and Louisiana grass. It

grows readily on almost any kind of fertile soil. It will grow in the wet places where the Bermuda does not thrive and consequently it is often found covering the wet places in a Bermuda pasture. Grazing animals usually prefer it to Bermuda and will keep it eaten off close to the ground. It is said to crowd out weeds and other grasses, especially in wet places. The seed is expensive and it does not catch well from seed. Yet, when once started, it spreads rapidly—one plant is said to cover 10 to 20 square feet in one season. It is not a hay plant but an excellent pasture plant, ranking next to Bermuda in the South. It can be readily destroyed by plowing and cultivation.

RAPE.

Rape is a pasture plant for hogs and sheep, and may be used for cows and other animals.

It requires a rich loam soil well supplied with humus, or vegetable matter, and a complete fertilizer may be used on the soil to the amount of 300 to 800 pounds per acre. Plow the land well and deep, harrow and thoroughly pulverize by use of roller, clod crushers, and harrow. Sow from 3 to 5 pounds of Dwarf Essex seed per acre in drills or 6 to 8 pounds broadcast and brush over lightly.

It may be sown in summer, fall or spring, when the ground is moist enough to germinate the seed. When sufficiently large, graze it with hogs or sheep by using hurdles or by letting them run on all of it. It will continue to grow for several months, if not eaten down too closely to the ground or allowed to go to seed. It may be sown in between cotton or corn rows in August or September. It will not grow in dry seasons.

ALFALFA.

Alfalfa is a perennial forage plant which may be kept growing for twelve or more years, provided the weeds and its parasites do not kill it. Almost any fertile lime land, with no "hard pan" or rock near the surface, will

grow alfalfa. It is necessary to have the bottom land well drained, for alfalfa will not thrive in wet soil. One without any experience should begin with a few acres. Select good lime land, and if it is not lime land, apply, after plowing, on each acre 2,000 pounds of air slaked lime or 4,000 pounds of ground lime rock. It is best to apply the lime a short time before sowing the seed and harrow the plowed land to mix the lime well with the surface soil. It will not be necessary to apply the lime again for 5 to 8 years.

In preparing the land for alfalfa, it is best to begin one to three years before sowing the seed. Add all the stable manure you can each year to the land, and grow cow peas or soja beans in summer in drill and cultivate so as to kill out all the weeds. In winter time grow crimson clover, hairy vetch or wheat, rye or barley. After two or three years apply well rotted stable manure and 500 pounds of 16 per cent. acid phosphate per acre. Plow 10 to 15 inches deep with disc plow or one to two inches deeper than the land has ever been plowed with a three or four horse turn plow, following in each furrow with a long scooter or subsoiler. Harrow and roll until you have a finely pulverized seed bed. After cutting off the oats, wheat, rey, barley, crimson clover, or hairy vetch, the land could be kept cleanly cultivated by shallow plowing once every one or two weeks until the middle of August. Then the manure and phosphate could be applied and the land be plowed deeply, harrowed and rolled. After plowing, apply the lime or lime rock. Always do this previous to harrowing and rolling. Some time from the middle of August to last of September, sow 20 to 25 pounds of good alfalfa seed (free from weed seed). Sow it evenly and broadcast it. In order to inoculate the soil and the seed, secure 100 pounds of rich dirt or soil from any field where alfalfa, mellilotus, or burr clover is growing or has grown within a year of the time you take the soil. Place this soil in a box, wet the alfalfa seed and thoroughly mix it with the pulverized

soil in the box. Sow the soil and seed broadcast over the acre of prepared land and brush in lightly.

As a rule the young plants will get sufficiently large to resist the freezing and lifting frosts of winter, and the next spring the young alfalfa will grow so early and rapidly that it will keep down the weeds. But should you fail to get a stand from the fall sowing, the same land may be easily prepared for seeding again in the same way and at any time from March 1 to April 1.

When the little branches begin to start out from near the base of the stem or just about blooming time, the alfalfa should be cut, and after removing the hay, the alfalfa stubble, if weedy, may be harrowed with a tooth harrow to destroy weeds and loosen up the ground. And after the first summer every time it is cut, it may be run over with a disc harrow having the discs set straight and then run over it in a direction at right angles to the way that the disc harrow ran, with a tooth harrow. This kills and keeps down weeds, loosens up the soil, admits air, and retains moisture.

The essentials for growing alfalfa are lime, manure, fertile soil, and absence of weeds, grass and parasites.

Dodder, or "love vine," is one of the worst parasitic enemies of alfalfa. When once started, it may be kept in check by hoeing it out and all the alfalfa for several feet around it. Pile up the dodder and alfalfa in the center of the cleared space and burn it when dry. Do not allow anything to grow on these bare places for one or more years. As a rule, the only way to kill out dodder in an alfalfa patch is to plow up the alfalfa and put that land in cotton and then in corn. Crab grass and chick weeds are plants that will crowd out or choke out alfalfa.

Crimson Clover.

This clover grows best in the fall, winter and spring, and may be sown in between the cotton or corn rows from latter part of August up to the fifteenth of October. If the ground is rich or has been made fertile by using stable

manure on the corn or cotton, 200 to 500 pounds of 16 per cent. acid phosphate and a little potash may be all the fertilizer required. Sow 20 pounds of good seed and cover with small harrow or shallow cultivation. If it is to be sown on freshly plowed land, it is best to run the roller over the ground after harrowing in the seed. When possible, secure 100 pounds of dirt from a field where red, white, or alsike clover or crimson clover has been grown luxuriantly within one year. Wet the 20 pounds of crimson clover seed and then thoroughly mix the 100 pounds of dirt with the seed. Now sow the mixture of dirt and seed on the freshly harrowed land. Harrow again after sewing, and then roll the land, if not in corn or cotton. This is to inoculate the seed and the land. It will not do to sow it in the late fall, in winter, in spring, or in early summer. It will be ready for cutting when it blooms in May or early June. It can be followed by cow peas, sorghum, soja beans, or late corn. In case you can not secure inoculated soil for inoculating the seed as above directed, use plenty of stable manure on a small piece of fertile land, and the next year the soil from this land will do for inoculating more seed and land. To be sure that a given soil is inoculated, examine the rootlets of the young or old clover plants growing on the land, for the bunches of little nodules. When the land does not contain lime, an application of 1,000 to 2,000 pounds of air slaked lime to the land before sowing the seed will help the growth of crimson clover. It should not be planted on wet land, or low undrained wet land.

Hairy Vetch.

One of the best legumes for collecting the nitrogen from the air, for making proteid or nitrogenous forage which is equal to wheat bran in feeding value, and for adding vegetable matter and nitrogen to the soil, is hairy vetch. It does not require lime land but some claim that it will grow best on sweet soil. It may be planted with winter oats, wheat, rye, or barley. But, as a rule, it does best

with oats. Yet it is rare that any of these cereals are ready for making the best hay when the hairy vetch is in bloom and ready for cutting. It can be sown on Bermuda sod in June, July or August. If the Bermuda is on rich land and is not pastured too close, the hairy vetch will take hold and grow vigorously after the fall rains. It would be better to cut up or scarify Bermuda sod with a scooter or some other plow and then sow the seed and harrow with a disc harrow. Hairy vetch may be drilled or sown in between the corn, sorghum, or cotton rows in August or September. If sown by hand, cover by shallow cultivation. It is well to use 300 to 500 pounds of 16 per cent. acid phosphate on each acre of land and a little potash. And if not inoculated, use plenty of stable manure. The seed and the land can be inoculated by getting a 100 pounds or more dirt from a field where hairy vetch or some other vetch grew the previous year or season, or from a place in the garden where English peas grew the previous year or season. Wet the seed with water and then mix the seed and dirt. Sow the mixture of dirt and seed over freshly harrowed or plowed land, and harrow again and then roll the land. This plant will stand more freezing than rye. Sow about thirty pounds of seed per acre. If used with oats or wheat, sow 1 to 2 pecks of hairy vetch seed with one to one and a half bushels of oats or wheat. The vetch seed may be sown with the inoculated dirt and then the wheat or oats can be sown broadcast or drilled.

ALSIKE AND RED CLOVER.

It is doubtful if either of these two clovers can be successfully grown anywhere south of the Tennessee river valley in Alabama. In all places where the land is "clover sick" for red clover, use alsike. Here I can not do better than quote a letter from Director H. A. Morgan of the Tennessee station: "Regarding the preparation of land for alsike clover or red clover, we handle it something this way: In order to rid the land of weeds, which are

natural upon most of our lands, put the land in peas, after making an application of lime—three or four thousand pounds to the acre of ground limestone rock and about two thousand pounds of the burnt lime. Disc this into the surface of the plowed ground a week or two before sowing the peas. After the peas are taken off, the land may be sown to a winter cereal, such as rye, wheat or fall oats, and, in early spring, seed to alsike clover, putting in plenty of good seed. We use as much as 10 to 12 pounds to the acre on our poor lands.

I do not believe, from our experience here, that it would be wise for you to recommend red clover until sufficient seed from immunized clover plants can be procured. Red clover is universally affected with a species of Colletotrichum, an anthracnose, and in the Middle Southern States undoubtedly dies from this disease. We have every promise, from our experiments with clover this year, finally to work out immune varieties, and I hope that this will be only a matter of three or four years. In the meantime, we are recommending alsike on well limed land. Alsike, as you remember noticeing when at the station, is exceedingly sensitive to an acid soil, and therefore accepts beautifully a lime application.

Mellilotus or Sweet Clover.

For the redemption of bare, poor lime lands no plant equals mellilotus. It is a bienniel and when once started will readily reseed itself if not kept from going to seed by frequent cutting with the mover.

The land should be well prepared and the seed sown in September or March, at the rate of 15 to 20 pounds per acre. It will do well on lime land where Johnson grass has a good hold. If cut early it will make good hay. It will also stand pasturing, but at first some animals must be kept on it for several days before they will eat it. The seed can be inoculated with dirt from an old mellilotus field or from a field of alfalfa or burr clover.

Burr Clover.

This is a close relative of alfalfa and is an excellent winter growing plant. It will grow on almost any kind of fertile soil that is not too wet. But it will grow best on lime land. It may be sown broadcast in between the cotton or corn rows just before the last plowing in June or July, using 2 to 3 bushels in the burr. Do not use the California burr clover seed. It can be sown broadcast, in June, July or August on scarified Bermuda sod, or on disced wheat, rye or barley stubble. If the seed with the burr removed is used, it may be sown as late as September. It is well to roll the land after harrowing in the seed that is sown in September. If not eaten off too close in the spring, it will reseed itself. In South Alabama it will furnish good winter pasture from December to April. Very cold weather may freeze back the top growth, but warm weather will bring it out again. As a rule the seed in the burr is inoculated, but it can be inoculated by using dirt from a mellilotus field, an alfalfa field, or a burr clover field. It is best to inoculate the seed that is cleaned of the burr, or use plenty of stable manure. Do not attempt to grow it on poor soil. Better grow a crop of cow peas on the land and then fertilize well before trying burr clover. This is not a good hay plant. Better plant hairy vetch, crimson clover, or red clover, or alsike clover for hay. Burr clover is a winter and spring plant.

No. 333.) AN ACT. (S. 165.

To establish a State Live Stock Sanitary Board and the office of State Veterinarian in order to further protect live stock from contagious and infectious diseases and provide for eradicating and excluding such diseases from Alabama.

Section 1. Be it enacted by the Legislature of Alabama, That from and after the passage of this act, the commissioner of agriculture and industries of the State of Alabama, the State health officer of Alabama, the pro-

fessor of animal industry and the professor of veterinary science, of the Alabama Polytechnic Institute shall, ex-officio, constitute a board to be known as the State Live Stock Sanitary Board. The commissioner of agriculture and industries shall be chairman and the veterinarian on the board shall act as secretary of the board. The State Live Stock Sanitary Board shall have full power to make or enact such rules and regulations as they may deem necessary for governing the movements, transportation or disposition of live stock that may be quarantined as hereinafter provided, on account of being affected with, or exposed to, a contagious or communicable disease, or on account of being infected or infested with the carrier or the carriers of the cause or the causes of a contagious infectious or communicable disease of live stock.

Sec. 2. Be it further enacted, That the professor of veterinary science of the Alabama Polytechnic Institute shall act as State Veterinarian of Alabama. The State veterinarian shall nominate, and the State Live Stock Sanitary Board shall elect, as many assistant State veterinarians and State live stock inspectors as they may deem necessary and as the funds at their disposal shall permit.

Sec. 3. Be it further enacted, That the State veterinarian is authorized and directed to quarantine a stall, lot, yard, pasture, field, farm, town, city, township, county, or any part of the State of Alabama when he shall determine the fact that live stock in such place or places are affected with a contagious, infectious, or communicable disease, or when said live stock are infested or infected with the carrier or the carriers of a contagious, infectious or communicable disease. The State Veterinarian or an assistant State Veterinarian shall give written or printed notices of the establishment of said quarantine to the owners or keepers of said live stock, and to the proper officers of railroad, steamboat, or other transportation companies doing business in or through the quarantined part or parts of the State.

Sec. 4. Be it further enacted, That no railroad company, or the owners or masters of any steam or other vessel or boat shall receive for transportation or shall transport live stock from any quarantined part into any other part of Alabama except as hereinafter provided. No person, corporation or company shall deliver live stock for transportation to any railroad company or sailing or steam vessel or boat in a quarantined part of Alabama, except as hereinafter provided. No person, company or corporation shall drive or cause to be driven, live stock on foot, or transport live stock in a private conveyance, or cause live stock to be transported in a private conveyance from a quarantined part to a non-quarantined part of Alabama, except as hereinafter provided.

Sec. 5. Be it further enacted, That live stock may be moved within the limits of a quarantined part or from a quarantined part of Alabama only under, and in compliance with, the rules and regulations of the State Live Stock Sanitary Board. It shall be unlawful to move or allow to be moved, any live stock from one place to another within the limits of a quarantined or from a quarantined part to a non-quarantined part of Alabama, in any other manner or method, or under any conditions other than those prescribed by the rules and regulations of the State Live Stock Sanitary Board.

Sec. 6. Be it further enacted, That all live stock, except such live stock as are to be used for immediate slaughter, when brought into Alabama by a person, company, corporation, railroad or other transportation companies, shall be accompanied by a certificate of health, and said certificate shall state that said animal or animals are free of contagious, infectious or communicable disease and the carrier or the carriers of the cause or the causes of such diseases. This certificate must be made by a qualified veterinarian immediately after he has personally eximined the live stock and before the live stock has been shipped into Alabama. This certificate shall be attached to, and accompany, the shipping bill of the live stock to

the place to which the live stock is shipped, and the owner of the live stock or agent of the transportation company shall mail or send said certificate to thė State veterinarian, immediately following the arrival of the live stock at its place of destination. The State veterinarian shall furnish qualified veterinarians and transportation companies with blank health certificates at actual cost.

Sec. 7. Be it further enacted, That owners, renters, or parties in possession of quarantined live stock or quarantined places shall follow the directions in the rules and regulations of the State Live Stock Sanitary Board in cleaning and disinfecting infected live stock and infested or infected quarantinėd places, and in destroying the carriers of the cause of a contagious, infectious or communicable disease, that infest or infect live stock and quarantined places. Said cleaning of said live stock and the disinfecting of said places and destroying of said carriers shall be done by the owners, or the parties in possession of the infected live stock and places, in a reasonable time after receiving a written or printed notice from the State veterinarian, an assistant State veterinarian, or a State live stock inspector. Any person, company or corporation violating the provisions of this section shall be guilty of a misdemeanor and on conviction, shall be punished for each and every violation by a fine not less than ten dollars, nor more than one hundred dollars, or by imprisonment not less than ten days nor more than sixty days, or by both such fine and imprisonment.

Sec. 8. Be it further enacted, That the State veterinarian, the assistant State veterinarian and the State live stock inspectors are hereby empowered to enter upon the premises or into any barns or other buildings where live stock are temporarily or permanently kept in the State of Alabama in the discharge of the duties prescribed in this act. Any person or persons who forcibly assault, resist, oppose, prevent ,impede, or interfere with the State veterinarian, an assistant State veterinarian, or a State live stock inspector in the execution of his or their

duties, or on account of the execution of his or their duties, on conviction, shall be punished as provided in Section 11 of this act.

Sec. 9. Be it further enacted, That the work of cattle tick eradication or the suppression or eradication of any other infectious, contagious or communicable disease of live stock shall be taken up under the provisions of this act in any county or any part of a county or any part of the State of Alabama, when the State Live Stock Sanitary Board may deem it best. The county commissioners of any county in which the State or Federal authorities take up the work of tick eradication or the suppression of any infectious, contagious or communicable disease of live stock, may appropriate, for aiding in such work, such sum as the county commissioners may deem adequate and necessary.

Sec. 10. Be it further enacted, That the State Live Stock Sanitary Board may appoint or elect the Federal veterinarians and live stock inspectors, who are doing work in Alabama, as assistant State veterinarians and State live stock inspectors; provided, they consent to act without pay from the State of Alabama.

Sec. 11. Be it further enacted, That any person, persons, company or corporation violating the provisions of Sections 4, 5, 6 or 8, of this act, shall be guilty of a misdemeanor and, on conviction, shall be punished by a fine of not less than fifty dollars, nor more than five hundred dollars, or by imprisonment of not less than one month nor more than six months, or by both fine and imprisonment.

Sec. 12. Be it further enacted, That there is hereby appropriated annually the sum of five thousand dollars to be disbursed under the direction of the State Live Stock Sanitary Board to pay the actual expenses of the Live Stock Sanitary Board in attending meetings; to pay for the printing of the official blanks the annual reports of the State veterinarian and the rules and regulations of the Live Stock Sanitary Board, to pay the State

veterinarian five hundred dollars per year and expenses while on actual duty; each assistant State veterinarian five dollars per day and expenses while on actual duty, and each State live stock inspector one to three dollars per day and expenses while on actual duty; and to pay such other expenses as may be necessary in carrying out the provisions of this act.

Sec. 13. Be it further enacted, That the judges of the circuit and criminal courts shall give this act in special charge to each future grand jury empanelled in this State, and that such grand jury be clothed with, and authorized to exercise inquisitorial power for the carrying out, and the enforcement of, this act.

Sec. 14. Be it further enacted, That the State veterinarian shall make an annual report to the Governor of Alabama, giving a full account of the work done and a detailed report of the money expended.

Sec. 15. Be it further enacted, That all acts not in accord with this act, are hereby repealed.

Approved March 12, 1907.

Official:

Frank N. Julian, Secretary of State.

BULLETIN NO. 142. MARCH, 1908.

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

Corn Breeding in Alabama

By

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Plant Physiologist and Pathologist.

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STATION COUNCIL.

ASSISTANTS.

The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

INTRODUCTION.

During the past decade a very large amount of attention has been given to corn breeding, particularly in the corn belt, by the various Experiment Stations and the United States Department of Agriculture. The practical value of such work has been so apparent that several private corn growers have undertaken the work and have made important contributions to our knowledge of the subject. The net result is that we now have a rather extensive literature that is freely available to all who are interested in this line of investigation. Several factors contributed to show the necessity of undertaking this line of work in Alabama, among the most important of which we mention:—(A) the low average yield per acre of corn. (B) the high market price of corn, and (C) the increasing need of a larger corn yield as feed for the rapidly increasing number of live stock being grown in this State. Besides it seemed important to undertake this line of work here to show exactly what could be done in developing a type of corn better suited to our needs in this latitude and one giving higher yields than the sorts in common cultivation. We therefore arranged to undertake this work, and in 1905 planted the first breeding plot. All of our corn-breeding work has been done on the "Hurstview" farm near Montgomery, and to Mr. Jesse M. Jones much credit is due for his very intelligent interest in the work and for numerous valuable suggestions made from time to time. My personal thanks are due to the Funk Brothers, Bloomington, Illinois, Professor P. G. Holden, of the Iowa Agricultural College, and Dr. Cyril G. Hopkins, of the University of Illinois, for numerous kindnesses and suggestions while visiting their institutions.

I am also under great obligations to various seedsmen and corn growers for seed furnished for the first year's work.

In this Bulletin we have given a summary of the most important practical results secured, but have purposely postponed for subsequent treatment some of the theoreti-

cal questions that have come to light during the work. The writer has not had a very large amount of time in the past to devote to this line of work, but it is to be hoped that the very satisfactory results secured will cause several progressive farmers to undertake similar work on their own farms. During the present season the author proposes to continue and intensify this line of work along certain important lines.

VARIETY OF CORN EMPLOYED.

The original ears employed in the first breeding plot were secured from the Mississippi Experiment Station and were of the sort called Mosby's Prolific. This is a corn of medium sized ear having white kernels on a white cob and with the stalk characteristics of the other prolific varieties. The mere name of the variety is of much less importance than its characteristics which have been found to be very well suited to the soil and climatic conditions of central Alabama where this work has been done. And yet the corn we have today differs in several marked particulars from the ears with which we started.

The following table shows the variation as to number of rows per ear for those ears planted each year in the breeding plots, in percentages.

Rows per ear	12	14	16	18	20
1905	1.66	43.33	50.00	3.33	1.66
1906	10.20	55.09	31.62	3.06	0.00
1907	9.18	52.03	28.56	8.16	2.04

It should be understood that no attention was given to the number of rows per ear in selecting the ears for the breeding plots.

The small cob generally found in the prolific sorts like Mosby has an advantage that in the South is of greater value than is ordinarily considered. A large cob is generally very sappy at harvest time, and thus such ears dry out more slowly than small ones, and the kernels are more easily injured by unfavorable temperature conditions and are more subject to rotting.

OBJECTS OF CORN BREEDING.

All plant breeding has for its object principally an economic one, i. e., the improvement of the plant with reference to some character considered important to man. This character may be one of yield, chemical composition or some mere question of beauty as in the case of decorative plants and flowers. In all cases the methods are much the same. The prime object in corn-breeding is the increase of yield and the development of sorts best adapted to the soils on which they are to be grown and to the climatic conditions there prevailing. In the Illinois work one of the main objects has been to develop strains of corn rich in one or more of the chemical compounds found in the kernel. As a result they have developed a "high-protein" corn and a "high-oil" corn and also a "high-combination" corn, i. e., one high in both protein and oil. But for the Alabama farmer the main point at present is to increase the yield. The present average yield in Alabama, according to the last census, is about 13 bushels per acre. The purpose of corn-breeding is to largely increase this low yield. And our results show that this object can readily be accomplished.

We must keep in mind, however, the desirability of correlating the high-yielding tendency with some character of the ear or stalk so that we can predict from a mere physical examination the probable yielding tendency of the progeny of a given ear or stalk. There can hardly be any question that uniformity of stalk and ear is a quality that we should strive to secure. As an example and illustration of what is meant by uniformity or conformity to type in the ear see Plate 2. A study of the ears shown on plates 3 to 7 inclusive will show that we have materially increased the uniformity of the Mosby corn.

It will no doubt be found desirable to secure by breeding and selection sorts of corn adapted to the various soil types found in the State. These soil types not only imply soils of different chemical and physical nature, but in many cases involve distinct methods of cultivation. In other words the methods of cultivation adapted to the sandy soils

of the wire-grass region would scarcely be desirable for the black-belt or vice versa. We would be pleased to undertake co-operative work in corn breeding with several farmers in various parts of the State to test some of these questions and to demonstrate the highly satisfactory results secured by intelligent selection.

THE EAR-ROW METHOD.

The ear-row method of corn breeding, which we are using, depends upon the well known individuality of the ear, i. e., its ability to transmit to its progeny various characteristics that it in turn has received from its ancestors.

The method may be briefly described as follows: We select 98 ears to be planted in what we call a "breeding plot" The tip and butt kernels are removed from each of these ears and the balance of the corn from each ear is planted in a row to itself. In our work we have planted the corn by machine in checks three feet and eight inches apart in both directions. One should have 98 rows from as many different ears and should mark each row with its proper number. The rows should be 100 hills long and in each hill just two stalks should be allowed to grow. This will save much calculation when the results are being worked up for comparison of the different rows.

During the growing season this breeding-plot is to be carefully watched to note any peculiarities that may appear in any of the rows. Plate 1 shows one row in one of the breeding plots that started its growth much more slowly than the adjacent rows. And as a matter of fact, the harvest showed conclusively that the ear from which this row was planted must have been weak in some particular. The progeny of this row does not enter into our subsequent work, as the yield from it was so low it was at once eliminated. Care should be taken to note any barren stalks and to detassel them at once to prevent the pollen from such worthless stalks falling upon the silks of any of the other stalks and thus perhaps perpetuating this tendency towards barrenness. One should also be on the lookout

for the finest stalks as to strength and number of good ears on them, and such stalks should be marked so that they can be told when the corn is harvested.

Desirable stalks are marked during the summer with tags of the form shown below:

O

Row .... **Ear No.** ....

Stalk

Height .... M.
Diameter .... Cm.

Leaves

No. ....
Length .... Cm.
Width .... Cm.

Ears

No. to Stalk ....
Height .... Cm.
Angle ....

Ear Stalk

Length .... Cm.
Diameter .... Cm.

At harvest time the ears selected for breeding purposes are marked in the following manner to show their origin and to connect them with the above data regarding the stalk on which they are produced. An ordinary gun wad has written on it the row and ear number, and this is attached to the butt of the ear by means of a strong pin known in the trade as "Bank Pins". These pins are driven into the butt of the ear, and in this manner the wad is rarely lost and can readily be seen when studying the ears in the laboratory. We of course gather a much larger number of ears in this manner than we subsequently use in the breeding plot, but for each ear we have all the data recorded on the tag referred to above.

BREEDING RECORDS.

It is absolutely necessary that detailed records be kept showing every character of each ear planted in the breeding plot. It is only by so doing that any definite progress can be made. For our work we are employing the following forms.

The form shown on page 9 is the one used in keeping our records of the characters of individual ears planted in the breeding plot. Our register number is so made as to indicate the crop-year in which the ear was produced, and the last two figures show the row number in which said ear is planted. For example, Register Number 642 shows that that ear was grown in 1906, and that it was planted in row 42 of 1907. We are attaching to each of these forms a photograph of the ear so that we believe we have a very satisfactory record of the ears we have employed.

The form shown on page 10 is the front page of our field record form. The form shown on page 11 is the back of this same sheet. This sheet is filled out for each row anl gives us the exact performance record of each ear planted in the breeding plot.

Annual Ear No.

PLANT		EAR		COB		KERNELS		Chem. Analysis	
Row No.		Weight		Weight		% Corn to Ear		Protein	
Plant No.		Length		Tip Circ.		Breadth		Oil	
Height		Shape		Butt Circ.		Depth		Starch	
Height of Lowest Ear		Tip		Color		Shape		Ash	
Height of Highest Ear		Butt				Indentation		Moisture	
No. of Ears		Tip Circ.				Color			
Ear-Angle		Butt Circ.							
Ear-Stalk		No. of Rows							
		Kernels to Row							
		Sulci							

(Devised by E. Mead Wilcox, 1904.)

Variety　　　　Ear Reg. No.　　　　Field

Source　　　　Row No.

	First	All	Average
Plant Up			
Tassel Out			
Silks Out			
Ear Mature			

	Total	%
Plants with marketable ears		
Number of marketable ears		
Plants without marketable ears		
Number of unmarketable ears		
Barren stalks		
Leaning and fallen stalks		
Plants with suckers		
Number of suckers		
Smutted plants		

	1	2	3	4	5	Av.
Diam. of stem at 20 cm.						
Height in meters						
Height of lowest ear						
Height of highest ear						
Ear-angle of good ears						
Ear-angle of rotten ears						
No. of leaves						
Blade - length						
Blade - width						
Ear-stalk - length						
Ear-stalk - diameter						
Ears per stalk						

(Devised By E. Mead Wilcox 1907)

Planted

Harvested

	Number of Stalks	Total No. of Ears	No. of Ears per Stalk	Wt. of Ears per Stalk	Total No. of Ears	Total Wt. of Ears	No. of Mark. Ears	Wt. of Mark. Ears	Av. Wt. per Ear
Row									
Acre									

CULTURE METHODS		Notes
How Planted		
Distance between rows		
1st cultivation		
2nd cultivation		
3rd cultivation		
Thinned		
Replanted		
Barren stalks detasseled		
Rows detasseled		

POLLINATION AND DETASSELING.

It has been estimated that a single tassel may produce as many as 50,000,000 pollen grains each one of which is sufficient to fertilize one ovule and produce one kernel of corn. These pollen grains to do this must fall upon the end of a silk that is ready to be fertilized, and there the pollen grain grows and sends a fertilizing tube down into the ovule at the base of the silk. The silks that are connected with the kernels at the base of the ear are fertilized first, and then from there towards the tip of the ear the work goes on. For each silk and each kernel therefore a single pollen grain is required. These pollen grains are blown about by the wind and may travel for some distance before falling on a silk. Of course large numbers are produced to be certain that enough fall on the silks to fertilize each one.

Now we may recognize three types of pollination or fertilization as follows:

1. The ovules of an ear are fertilized by the pollen of the tassel on the same stalk. This is called inbreeding, or self-pollination.

2. The ovules of an ear are fertilized by the pollen from the tassel of a stalk that arose from kernels produced on one and the same ear. That is these stalks might be called sister stalks and this type is called close-breeding or close-pollination.

3. The ovules of an ear are fertilized by the pollen of the tassel of a stalk not closely related to the ear stalk. This type is called cross-pollination or cross-breeding.

Now in the field and in the ordinary breeding plot some inbreeding probably occurs, but in the breeding plot we may have continuous and injurious amounts of close-breeding and this must be prevented. This is to be prevented by detasseling and gathering the seed corn for the next year's breeding plot from the detasseled rows alone.

Our plan is shown by the following diagram in which stars show stalks not detasseled and D denotes detasseled

stalks. Of course the diagram does not show all the stalks in the plot, and shows only ten of the rows:

D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D

In other words, it is seen that we detassel alternate halves of adjacent rows. Our seed corn is then gathered only from the halves of each row that have been detasseled.

This work of removing the tassels can not be done at one time, but must be looked after at intervals of a week or more until the tassels cease appearing. Just before the tassel is exposed one can, by gently opening the leaves, take a firm grasp on the tassel and remove it by a steady pull, without injuring the stalk at all.

CULTIVATION OF THE BREEDING PLOT.

The important thing in corn culture is frequent and shallow cultivation. Our breeding plot receives 4 to 6 cultivations and one or more hoeings. Too good care cannot be taken of the breeding plot, for from it you are to secure your improved corn for future planting. At harvest time the plot should be free of weeds, at least this is the ideal condition towards which you should aim. For further information on this subject, and upon the question of fertilizers and other matters of this nature see the Bulletins of the Alabama and Georgia Experiment Stations on Corn Culture.

SOME RESULTS SECURED.

The increase in yield we have secured is well shown by the following table, which gives the percentage of the rows each year that have been above and the percentage of the

rows that were below the average yield for all the rows of that year:

	Average.	P.C. of rows above.	P.C. of rows below.
1905	30.79	41.6	58.4
1906	36.62	47.9	52.1
1907	36.85	50.0	50.0

A comparison of the average or mean yield for 1905 with that for 1907 shows that we have increased the yield in three years 19.6 per cent.

The following table gives the yields of the fourteen best rows of the crop of 1907, together with the yields of the rows during the two preceding years which have been the ancestors on the female side of each of the fourteen ears. The yields are given in bushels per acre as calculated from the actual yields of the rows. In each case the yield is calculated to a perfect stand:

1907	1906	1905
642	537	425
53.7	41.9	43.9
650	550	433
51.2	36.2	58.2
691	539	435
49.2	50.4	35.4
652	522	429
46.9	37.7	37.7
623	535	445
45.3	40.8	34.7
661	551	422
45.1	43.9	35.1
649	593	458
44.1	39.6	39.8
656	527	429
42.9	35.6	37.7
630	510	443
42.3	49.9	39.8

684	510	443
42.1	49.9	39.8
647	577	418
41.6	45.3	31.6
645	583	417
40.8	40.0	25.2
653	519	426
40.5	37.9	42.9
646	513	425
40.5	35.2	43.9

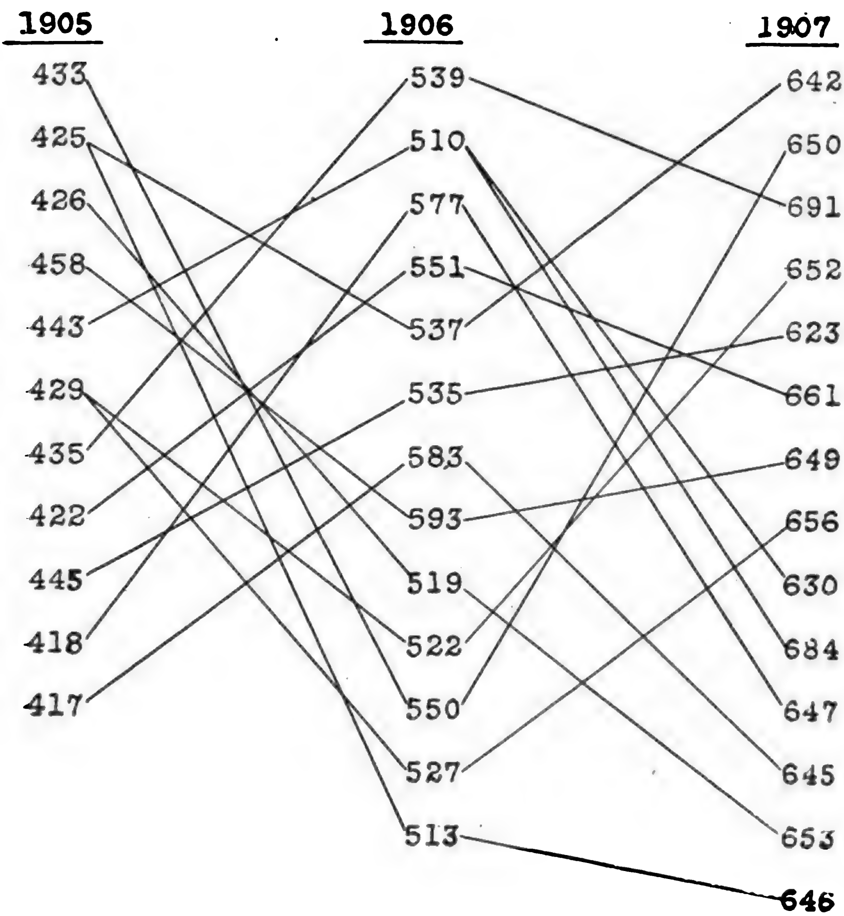


FIG. 1. Chart showing the pedigree of the fourteen best rows of the 1907 crop.

TESTS OF MOSBY CORN BY FARMERS.

The following yields are taken at random from a larger number of reports made by farmers in various parts of the State who have planted corn purchased from Mr. Jones. This corn was taken from the breeding plot of 1906:

J. G. Little, Greenville, 60 bushels.

Clark Adams, Greenville, 65 bushels.

Geo. A. Watson, Monroeville, 72.5 bushels.

W. M. Newton, Belleville, 97.75 bushels.

H. E. Hudson, Monroeville, 30 bushels.

HOW TO BEGIN CORN-BREEDING.

A farmer who desires to begin the systematic selection of corn should proceed as follows: During this season study carefully your field of corn and select enough of the best stalks to give you at least 200 ears. It does not matter about the name of the corn so much as it does about its being suited to your local conditions and to yourself. Where the land will stand it you had best select one of the prolific sorts, but under other conditions a 1-eared sort may be better. Allow the ears so selected to mature on the stalks, and under no circumstances "pull" the fodder from these stalks. When mature gather these ears and tag them in such a way that you will know the sort of a stalk each came from. These ears constitute your basis for further improvement, and should be well cared for during the winter.

PREVENTING INJURY BY WEEVILS AND MICE.

The corn for the breeding plot should be stored during the winter in some dry and cool place and in some barrel or box to which mice cannot enter, and tight enough to permit of fumigation against weevils. A good method to fumigate against weevils is to place the ears in a tight box or barrel and place an ordinary tea cup half full of carbon bisulphid on top of the corn and cover the whole with a blanket. After twenty-four hours every weevil will be dead. The corn should then be examined at intervals dur-

ing the winter to see that weevils or mice have not entered the barrel.

SELECTING THE EARS FOR THE BREEDING PLOT.

During the winter while you have time study these 200 ears by means of the score card, and from them select the 98 best ears for the breeding plot.

THE SCORE CARD AND CORN JUDGING.

The main value of the score card to the corn grower is that it causes him to give close attention to the various characters of the ear and teaches him the most desirable features to be looked for in the corn he is breeding. We are well aware that in the ordinary corn shows and in ordinary corn judging little or no attention is given to the relative yields of the ancestors of the various ears being compared. In other words the ears in the exhibit are compared to one another without any reference to the performance record of their parents which may well be expected to appear in the progeny of the ears. For example, it might be possible to gather two samples showing equal perfection as to the points mentioned on the score card, but one sample might have come from a field yielding 50 bushels to the acre and the other from a nearby field yielding but 10 bushels to the acre. But from his high yielding rows in the breeding plot the corn grower must be able to select the ears which are best from the standpoint of the score card.

It must be left to future work to develop a score card that is well adjusted to our Alabama types of corn and for the present we offer the score card employed by the author in order to call attention to this line of work:

1.	Uniformity.	
	A. Trueness to type	10
	B Uniformity of exhibit	5
2.	Shape of ear	5
3.	Color	10
4.	Market condition	10
5.	Tips	5

6.	Butts	10
7.	Kernel uniformity	5
8.	Kernel shape	5
9.	Length	10
10.	Space.	
	A. Space between rows	5
	B. Space between kernels at the cob	5
11.	Percentage of corn to cob	15
	Total	100

SUGGESTIONS AS TO USE OF SCORE CARD ON MOSBY CORN.

1. The deficiency and excess in length of the ears that do not conform to the standard for the variety shall be added together and a cut of one point made for each inch thus secured. For the Mosby corn the standard length shall be 8 inches.

2. The deficiency and excess in circumference of all the ears that do not conform to the standard for the variety shall be added together, and for every two inches thus secured a cut of one point shall be made. The standard circumference, taken at one-third the distance from butt to tip, in the Mosby corn shall be 6 inches.

3. The shape of the ear in the standard is such that the proportion between length and circumference is the same as 4 to 3. Cut each ear that is off, 1-2 point.

4. For kernels off in color, i. e., yellow in the case of Mosby corn, cut 1-4 point for each two kernels. That is for 6 yellow kernels, cut the ear 3-4 point.

5. For a red cob in Mosby corn cut each ear 2 points.

6. Vitality is indicated finally by the germination test, but this is out of the question for score card purposes. The ears should be well-matured, firm and sound. For each ear that is off cut 1-2 point.

9. The kernels should be of uniform shape and true to the type. For each ear that is off cut 1-2 point.

10. The kernels should be so shaped that their edges touch from tip to crown. Cut 1-2 point for each two kernels not so shaped.

11. The proportion of corn to ear should be from 85 to 90 per cent. in the case of the Mosby corn. For every per cent below this standard cut the exhibit 1-2 point.

TESTING THE VITALITY OF SEED CORN.

This should never be neglected for the breeding plot, and would prove of great value even in the general fields. When we remember that 15 to 20 ears should give plenty of corn to plant an acre, we see that the time and labor to test enough corn for even large fields is not very great. It will certainly pay in better stands of corn and larger yields. The method is simple and requires no expensive apparatus. A box should be made 12 by 18 inches inside and about 3 inches deep. Do not make this water tight. At the bottom of this place two thicknesses of canton flannel moistened with water. The upper side of this cloth should be marked off into squares 2 inches square with a lead pencil These squares should be numbered from 1 to 54. Now from the ears numbered in the same manner remove six kernels as follows: Near the base of the ear remove two kernels on opposite sides of the ear. Near the tip select two kernels also on opposite sides of the ear and directly above those previously removed. Then from near the middle of the ear remove two kernels from opposite side of the ear but at right angles with the kernels already removed. These six kernels are to be placed with the germ up in the square having the same number as that on the ear. Proceed in this manner until all the ears have had samples taken for the test. Then cover the kernels with two thicknesses of canton flannel. Sprinkle with water and cover the box with a piece of glass. Ordinarily no more water will be needed. But if so it should be simply sprinkled over the upper piece of cloth. At the end of six days examine the

kernels by carefully removing the upper cloth. Ears whose kernels have not given a good strong sprout should be discarded. If any ears must be discarded select others to take their places and proceed to test their vitality.

SHELLING CORN FOR PLANTING.

To secure the corn from the breeding ears for planting first discard the tip and butt kernels. Then remove all the balance of the corn with the exception of two adjacent rows which are to be left as a means of telling at any time the character of the ear and its kernels. This ear should be tagged with a number so that it may be told at any time. These samples should be stored where they will not be injured. The corn should be placed in a paper sack until wanted for planting, so that there is no danger of mixing it with the corn from other ears.

BREEDING PLOT.

This should be the best and most uniform piece of ground on your farm, and be isolated to prevent the pollination of any of the silks by foreign pollen. The other details as to planting and care of the breeding plots have already been described.

MULTIPLYING PLOT.

After selecting the breeding ears for the next year all the remaining good ears should be saved to be planted in the multiplying plot. Place this plot where no foreign pollen can reach it. The corn from this field is to be selected and planted the following year in the general field as follows:

1908	1909	1910
		B. P.
B. P.	B. P.	
		M. P.
	M. P.	G. F.

In this diagram B. P. stands for the breeding plot, M. P. for the multiplying plot, and G. F. for the general field.

THE FUTURE OF CORN BREEDING IN ALABAMA.

There is no doubt that corn-breeding will in the near future occupy much more attention at the hands of Alabama farmers than at present. To the man who engages in it now with the determination to produce the best type of corn possible this field of work offers good returns on the time and money invested. Not only will the individual corn-breeder secure higher yields, but there is a fine chance to dispose of high-grade seed corn when it is backed by good honest work and detailed records as to pedigree. The time is coming when more and more people will demand seed corn on the ear and from fields that have given high yields. We should be glad to enter into correspondence with all persons interested in this line of work, and stand ready to offer the best suggestions we have on the subject.

LITERATURE OF CORN BREEDING.

The following list includes some of the more important publications of the Experiment Stations and United States Department of Agriculture that should be read by farmers who desire to undertake work along this line. Publications referring particularly to sweet corn are omitted:

Card, F. W.

1906. Corn Selection. Bull, R. Is. Exp. Stat. 116: 1-35. Fig. 1-9.

Davenport, E.

1906. Methods of testing variability in corn. Circ. Ill .Exp. Stat. 101:1-7.

Davenport, E., and Rietz, H. L.

1907. Type and variability of Indian corn. Bull. Ill. Exp. Stat. 119:1-29.

Crosthwait, G. A.

1907. Indian corn. Its production and improvement. Bull. Idaho Exp. Stat. 57:1-59. plate 1-11.

Duvel, J. W. T.

1906. The germination of seed corn. Farmers' Bulletin 253:1-16. fig. 1-4.

East, E. M.

1906. The improvement of corn in Connecticut. Bull. Conn. Exp. Stat. 152:1-21.

Hartley, C. P.

1903. Improvement of corn by seed selection. Yearbook U. S. Dept. Agr. 1902:539-552. plate 71-77.

1904. Corn Growing. Farmers' Bulletin 199:1-31. fig. 1-23.

1905. The production of good seed corn. Farmers' Bulletin 229:5-20. fig. 1-10.

Hayward, H., and Jackson, H. S.

1907. A study of Delaware seed corn with some suggestions for its improvement. Bull. Del. Exp. Stat. 77:1-16. fig. 1-10.

Holden, P. G.

1902. Storing and purchasing seed corn. Press Bull. Iowa Exp. Stat. 4pp.

1903. Selecting and preparing seed corn. Bull. Iowa Exp. Stat. 68.

1904. Selecting and preparing seed corn. Bull. Iowa Exp. Stat. 77.

1905. Selecting and preparing seed corn. Bull. Iowa Exp. Stat. 77.

Hopkins, C .G.

1898. The chemistry of the corn kernel. Bull. Ill. Exp. Stat. 53.

1899. Improvement in the chemical composition of the corn kernel. Bull. Ill. Exp. Stat. 55.

1902. Methods of corn breeding. Bull Ill. Exp. Stat. 82.

Hopkins, C. G., Smith, L. H., and East, E. M.

1903. The structure of the corn kernel and the composition of its different parts. Bull. Ill. Exp. Stat. 87.

1903. Corn experiments in Illinois. Circ. Ill. Exp. Stat. 66.

1905. Directions for the breeding of corn, including methods for the prevention of in-breeding. Bull. Ill. Exp. Stat. 100.

Hume, A. N.

1904. The testing of corn for seed. Bull. Ill. Exp. Stat. 96.

Miller, M. F.

1905. Suggestions for Missouri corn growers. Circ. of Inform. Mo. Exp. Stat. 19.

Scherffius, W. H.

1905. A method of selecting seed corn. 2. A chemical study of the composition of a number of varieties of Kentucky corn. Bull. Ky. Exp. Stat. 122.

Scofield, C. S.

1903. The commercial grading of corn. Bull. Bur. Plant Industry U. S. Dept. Agr. 41.

Shamel, A. D.

1901. Seed corn and some standard varieties for Illinois. Bull. Ill. Exp. Stat. 63.

Shoesmith, V. M.

1906. The study of corn. Bull. Kan. Exp. Stat. 139.

Smith, L. H.

1904. Directions for the breeding of corn. Circ. Ill. Exp. Stat. 74.

Soule, A. M.

1904. Increasing the yield of corn. Bull. Tenn Exp. Stat. 17-2.

Tucker, G. M.

1902. Corn improvement for Missouri. Bull. Mo. Exp. Stat. 59.

Walls, E. P.

1905. The influence of the size of the grain and the germ of corn upon the plant. Bull. Md. Exp. Stat. 106.

Webber, H. J.

1905. Selection and care of seed corn. Farmers' Bulletin 229: 21-23.

Wiancko, A. T.

1905. Corn improvement in Indiana. Bull. Ind. Exp. Stat. 105.

1906. Corn improvement. Bull. Ind. Exp. Stat. 110.

Willard, J. T.
1902. Analyses of corn, with reference to its improvement. Bull. Kans. Exp. Stat. 107.
Williams, C. B.
1903. Improvement of corn by seed selection. Bull. N. Car. State Bd. Agr. 24-9.
1906. Selecting seed-corn for larger yields. Bull. N. Car. State Bd. Agr. 27-8.
Williams, C. G.
1903. The corn crop. Bull. Ohio Exp. Stat. 140.
1905. Pedigreed seed corn. Circ. Ohio Exp. Stat. 42.
1906. Experiments with corn. Circ. Ohio Exp. Stat. 53:1-11.
1907. Corn breeding and registration. Circ. Ohio Exp. Stat. 66.
1907. The selection of seed corn. Circ. Ohio. Exp. Stat. 71.
Wing, D. C.
1904. The improvement of corn in Pennsylvania. Bull. Dept. Agr. Penn. 133.
Schulte, J. I.
1907. Corn-breeding work at the Experiment Stations. Yearbook U. S. Dept. Agr. 1906:279-294.
Soule, A. M., and Vanatter, P. O.
1907. The improvement of corn. Bull. Va. Exp. Stat. 165.

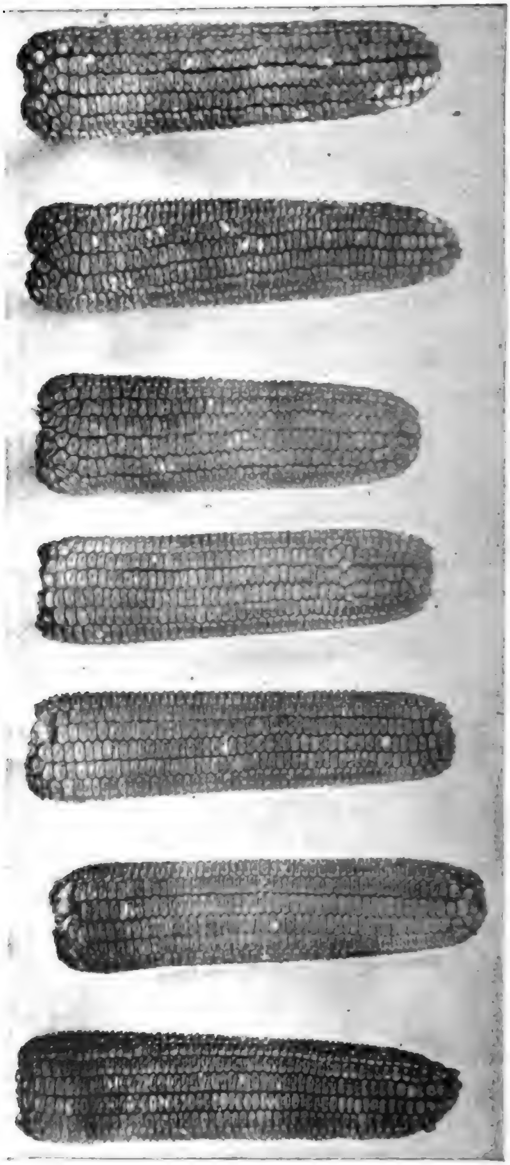
EXPLANATION OF PLATES.

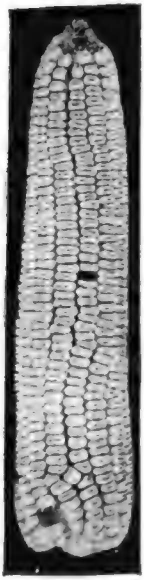
Plate 1. Individuality of the ear as shown by differences in height of the stalk during the season. Note particularly the low row in the center of the field.

Plate 2. Funk's Yellow Dent corn grown by Funk Brothers of Bloomington, Illinois. Note the great uniformity of the ears.

Plates 3 to 7 inclusive. Showing the ears in the ancestry of the ten best ears grown in the breeding plot during 1907. The ears marked with numbers in five hundred were grown in 1905, those marked in six hundreds were grown in 1906, and those marked in seven hundreds were grown in 1907. Ear 702 was from row 42 of 1907, and this in turn from row 37 of 1906. Each horizontal series of three ears is similarly related.

PLATE II.





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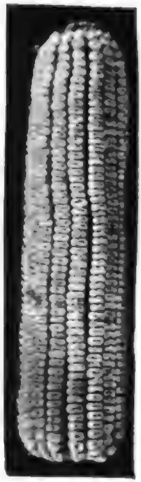

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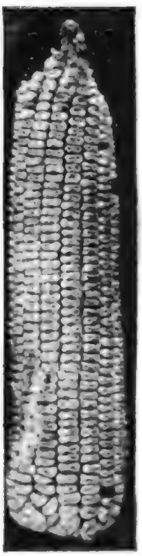

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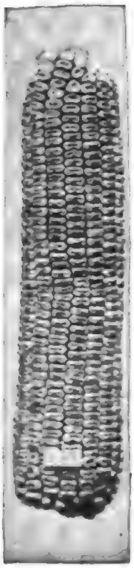

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PLATE IV.

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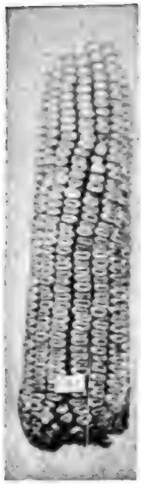

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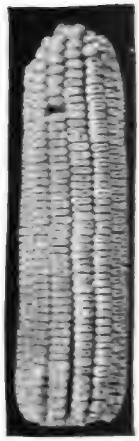

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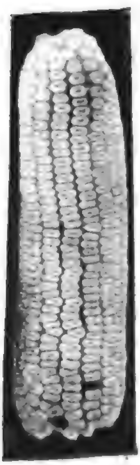

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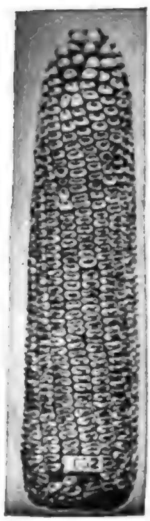

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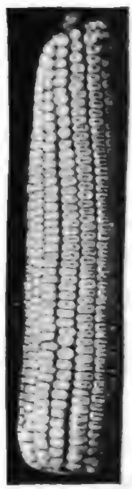

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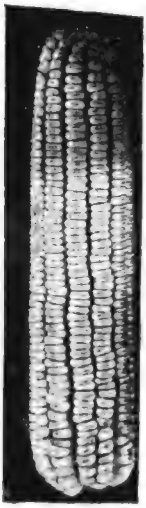

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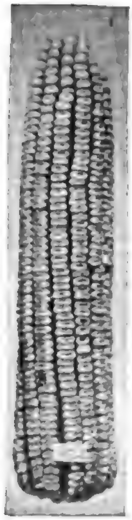

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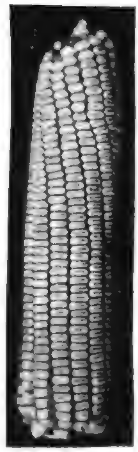

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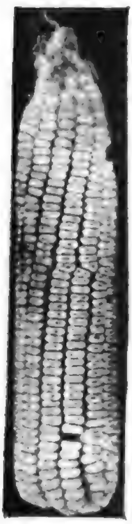

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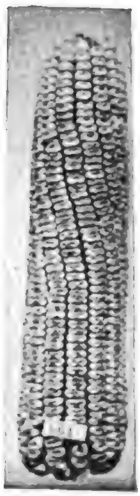

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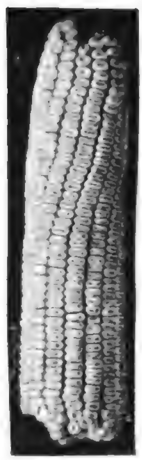

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PLATE VI.

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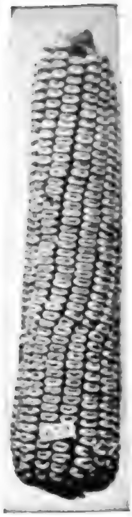

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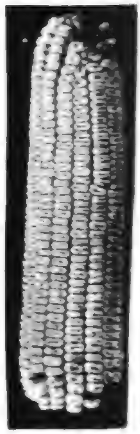

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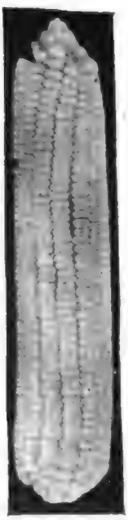

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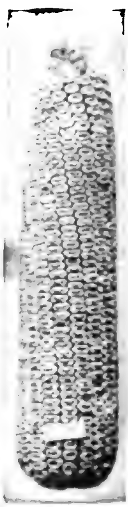

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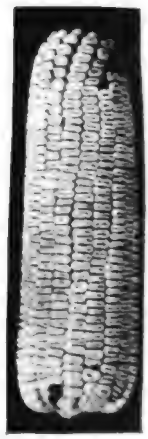

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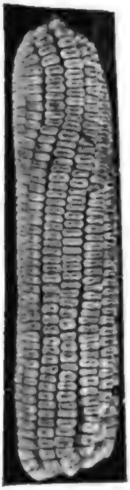
PLATE VII.



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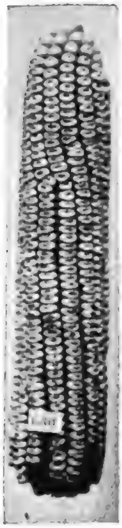

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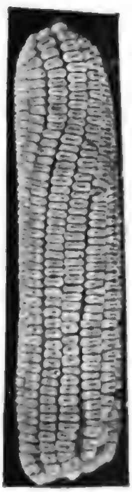

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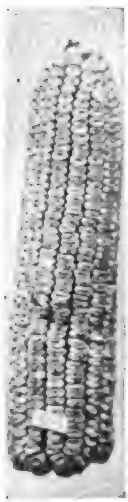

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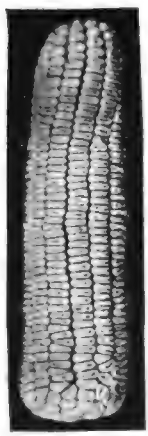

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Feeds Supplementary to Corn For Southern Pork Production

BY

DAN T. GRAY, J. F. DUGGAR, J. W. RIDEGWAY

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FEEDS SUPPLEMENTARY TO CORN FOR SOUTHERN PORK PRODUCTION.

By

D. T. Gray, J. F. Duggar, J. W. Ridgeway.

SUMMARY.

1. This bulletin records a summary of three years' work in swine production, in which 90 hogs have been used.

2. The object in presenting this bulletin is to get together the three years' work so as to make a comparison between finishing hogs upon corn alone and finishing them upon corn supplemented with either green crops or concentrates.

3. When corn was used alone as a ration for fattening hogs both the daily gains and the financial outcome were unsatisfactory. Money was lost in every case where corn was fed without a supplement.

4. When corn was supplemented with a partial ration of cotton seed meal the daily gains and the financial outcome were satisfactory. Four deaths occurred as a result of the use of cotton seed meal, *but these deaths did not occur while the animals were eating the meal. All of the deaths have occurred soon after the animals were taken off of cotton seed meal and placed upon a ration which contained no cotton seed meal.* This suggests the idea that cotton seed meal may be stimulating in its effects—similiar to the action of certain drugs—and when it is removed suddenly from the animals that death may occur through depression.

5. Tankage, a packing house by-product, proved to be an exceedingly satisfactory feed to supplement corn. In fact, it was almost as satisfactory as cotton seed meal, and it has the advantage over cotton seed meal in that there is no danger in feeding it.

6. When corn was supplemented with a ration of one-half cowpeas (the seed) the results were more satisfactory than when corn was used alone, valuing the cowpeas at

80 cents per bushel. The peas were used profitably until they reached a price of $1.05 per bushel.

7. As a whole, peanut pasture was found to be more useful than any other pasture tried. Notwithstanding the fact that the peanut pastures were not good two years out of the three they still gave excellent results. Pork was made at a good profit when peanut pasture was used in conjunction with corn.

8. Mature sorghum pasture has very little to recommend it as a feed for fattening swine. Both the gains and the financial outcome were unsatisfactory.

When the sorghum was cut and carried to the hogs the results were better than when the hogs were made to graze the crop.

9. The expense of extracting the juice from the sorghum and feeding the juice only prohibits its use in this way, although excellent daily gains were made. In no case was the juice found to be worth more than 1.8 cents a gallon as a feed for hogs.

10. Soy bean pasture ranked second to peanut pasture as a supplement to corn.

11. Chufa pasture was not found to be as good as either peanuts or soy bean pasture.

12. The average daily gains were as follows: corn alone, .69 of a pound; corn 2–3 of the ration plus cotton seed meal 1-3, 1.04 pounds; corn 9-10 plus tankage 1-10, 1.04 pounds; corn 1–2 plus cowpeas 1–2, .94 pounds: corn plus peanut pasture, 1.01 pounds; corn plus sorghum pasture, .37 pound; corn 2–3 plus cotton seed meal 1–3 plus peanut pasture, 1.00 pound; corn 2–3 plus cotton seed meal 1–3 plus sorghum pasture, .46 of a pound; corn plus chufa pasture, .72 of a pound; corn plus soy bean pasture, 1.02 pounds; corn 2–3 plus cotton seed meal 1–3 plus soiled (cut sorghum), .75 of a pound.

13. The cost of one hundred pounds gain in each case, when the cost of putting in and cultivating the pasture crops was not taken into consideration, was as follows: corn alone, $7.63; corn 2-3 plus cotton seed meal 1-3, $5.75;

corn 9–10 plus tankage 1–10, $5.18; corn 1–2 plus cowpeas 1-2, $5.11; corn plus peanut pasture, $2.28; corn plus sorghum pasture, $5.46, corn 2–3 plus cotton seed meal 1–3 plus peanut pasture, $1.97; corn 2–3 plus cotton seed meal 1–3 plus sorghum pasture, $4.85; corn plus chufa pasture, $3.81; corn plus soy bean pasture, $1.96; corn 2–3 and cotton seed meal 1–3 plus soiled sorghum, $3.39.

14. The cost of one hundred pounds gain in each case, when the cost of putting in and cultivating the pasture crops was counted against the gains, was as follows: corn alone, $7.63; corn 2-3 plus cotton seed meal 1-3, $5.75; corn 9–10 plus tankage 1–10, $5.18; corn 1–2 plus cowpeas 1-2, $5.11; corn plus peanut pasture, $3.20; corn plus sorghum pasture, $11.90; corn 2–3 plus cotton seed meal 1–3 plus peanut pasture, $2.14; corn 2–3 plus cotton seed meal 1–3 plus sorghum pasture, $7.79; corn plus chufa pasture, $8.89; corn plus soy bean pasture, $2.74; corn 2–3 plus cotton seed meal 1–3 plus soiled sorghum, $4.86.

15. When hogs have been grazing a green crop it usually pays to inclose and feed them in a dry lot for a short period after the crop is exhausted.

16. When corn was fed alone but 48 cents was realized upon each bushel of corn used. The way to secure a better price for the corn is to feed it in combination with some other feed.

17. When hogs sell for from 5 to 7 cents a pound live weight the farmer cannot afford to sell his corn for 70 cents a bushel.

INTRODUCTORY.

While Alabama produces a portion of the pork that her people consume she falls far short of meeting home demands. Much of the pork we use is made in Illinois, Iowa, Ohio, and other northern states. It costs the farmer as much, and perhaps more, in those states to produce a pound of pork than the same pound would cost if produced by the Alabama farmer; under present conditions our people pay those northern farmers a good profit upon their pork-making operations and in addition, pay heavy freight

rates to get the meat transferred to the South. It is no uncommon sight to see the Alabama farmer hauling to his country home meat killed in Chicago. This meat costs from 10 to 12.5 cents at present prices—and it is a cheap quality of meat at that. The Alabama farmer could have made that pork upon his own farm for about one-half the above expense, and by the judicious use of supplementary feeds, could have the meat for at least one-third of what he must pay for it at the grocer's store. Besides getting the meat cheaper, thus saving his money, he would have upon his table first class hams, ribs, and chops instead of the poorer quality of side meat.

Object of Experiments.

These experiments were planned with a three-fold object in view:

1. To compare finishing hogs upon corn alone (the usual method followed in the South) with finishing them upon corn supplemented in some cases with a concentrated feed and in some cases with green crops.
2. To study the efficiency of different feeds, or combinations of feeds, in hardening the flesh of hogs after it has been rendered soft as a result of the animals grazing peanuts.
3. To study the effect of different feeds—with special reference to cotton seed meal—upon the strength, chemical composition, and histology of the bones.

The first object only is dealt with in this bulletin. The other two will receive consideration in a later report.

Animals Used.

This report is based upon three years' experimentation and can be considered only as a report of the progress of the work. Ninety hogs have been used during these three years, divided into numerous lots—six lots each year. While definite conclusions could not be drawn from the data collected through the use of so few animals in a single year's work, yet the test has been repeated in many respects the third year, so the conclusion drawn can be

regarded as fairly accurate and trustworthy. The hogs used, while perhaps somewhat better in quality than the average hogs of the state, can be considered about equal to the animals which our best farmers keep upon their farms. They were picked up from neighboring farmers around Auburn, and all of the animals had some improved blood in them. This improved blood consisted largely of Poland-China or Berkshire blood; there were also a few Yorkshire grades. A few of the animals showed close kinship to the "razor backs." At the beginning of the test they averaged something like seventy pounds in weight, and probably averaged five months in age.

Quarters.

The pigs which were fed upon concentrates only were confined in dry lots which had a good open shed across one end which afforded them protection from both the hot sun and the cold rains. These lots were about 30 by 100 feet in size. The hogs which were running upon a pasture crop were confined upon these crops by means of a moveable fence (or hurdles); these lots were also afforded shelter from the hot sun by means of trees and bushes or by artificial structures. All the pigs in all cases were made comfortable. When the pigs were grazing a green crop, in some cases they were given the run of but a small area at a time, and the hurdles were then moved forward on a new area, but in other instances the whole area was fenced in and the animals given the privilege of running upon the whole area at one time. There is perhaps a smaller waste when but a small area is grazed at a time, but the labor in moving the fence is not inconsiderable if the areas are made too small.

Division Into Lots.

Each year when the pigs were brought to the Animal Industry farm the whole lot was put under similiar conditions a sufficient length of time to establish uniformity, after which time, they were carefully divided into six lots as nearly equal as possible in quality, age, size, weight, sex

and breed with previous condition and raising taken into consideration.

Feeding.

All of the lots were fed twice daily throughout the entire tests, as nearly as possible at the same hour each day, so as to avoid producing restlessness among the pigs. With the exception of the year 1905–'06 the corn was ground and fed in a slop. When the corn was fed with other concentrates the two were always mixed together and fed as a slop. During the years 1905–'06 and 1906–'07 the cotton seed meal was always fermented, or soured, twenty-four hours before feeding, but during the last year, 1907-'08, it was taken directly from the sacks, mixed with the corn meal, and given to the hogs. Those rations which contained cotton seed meal were fed in a very thin slop—in fact so thin that the animals could drink the feed rather than eat it. It was soon learned that when the cotton seed meal was fed in an exceedingly thin slop that the pigs always maintained a keen appetite for the feed, no matter how long they were kept on the feed, but when the ration was placed before them in a dough state it would be but a few days until the whole pen would "go off feed".

All green crops used by the hogs were gathered by the hogs themselves, except in one case in 1905–'06 where sorghum was cut and carried to one lot confined in a pen in order that a comparison might be made with sorghum grazed and sorghum fed in a dry lot (soiled).

All the lots at all times had a mixture, consisting of salt, coal and lime, before them. It was very noticeable that those pigs upon corn alone ate much more of this mixture than did the other lots.

The quantity of food given those pigs which were confined in the lots was gauged by their appetites, the object being to give each lot all it would eat up clean and still retain the appetite. The lots which received a green ration in addition to the grain were not given a full grain ration. Such lots received a grain ration equal to two per cent of the total live weight of the lot; for instance, if

a certain lot weighed 800 pounds the daily grain ration would have been 16 pounds. Thus the lots on pasture crops received what may be considered about half a full ration of concentrated food.

The Pasture Crops.

The sorghum crops were as good each year as they could be expected to be when grown upon poor sandy soils. The sorghum was grown in drills and cultivated. The yields, green weight, averaged about eight tons to the acre. The hogs were turned upon the pasture just about the time the juice began to sweeten—or about the time the heads began to turn black, when the sorghum plants were usually 5 or 6 feet high. It was hard work for the hogs to graze the sorghum as the juice was secured so slowly by them that they were never satisfied; so they put in pratically all their time riding down the stalks and chewing the cane; this is not conducive to rapid and economical gains. The peanut crops were not as good as the sorghum crops. In 1905–'06 there was practically a full stand and yield of peanuts. In 1906-'07 there was a very poor stand and not more than a 40 percent yield. In 1907–'08 the yield and stands were even poorer than the previous year. The poor stands and yields were largely due to the fact that labor could not be secured to work the crops after they were put in.

The chufa crop was an average crop, and the soy bean stand was not far below the average, but the yield was cut down somewhat on account of the extremely dry weather just at the time the beans were maturing, so that they finally yielded about 70 per cent of a normal crop. The hogs were turned upon the soy beans two weeks before the beans were matured enough to be eaten, so for the first two weeks the animals ate nothing but the leaves in addition to the corn they received; the records show that the animals made satisfactory gains even these first two weeks.

Periods.

Each year's work was divided into periods because the

nature of the work required that it be thus divided, as one of the main points was to study the effect which different feeds might have upon the melting point of the lard when following other feeds, as peanuts. The first year's test, 1905–'06, was divided into two periods. The two following years' work were divided into three periods each. Each period varied in length from twenty-eight to fifty days, thus making each full experiment from ninety to one hundred and ten days in length.

Slaughter Data.

At the end of each period one animal from each lot was slaughtered and careful notes collected upon the dressed weights, appearance of the carcasses, the rapidity and the extent of the "setting", the appearance and weights of the internal organs, etc. Samples of fat were taken from each carcass and turned over to the chemist, Professor Hare, who made melting point determinations, and further studies to learn the effect of different feeds upon the fat of swine. The fifth, six, and seventh ribs were also taken from each animal slaughtered with a view to making a chemical and histological study of the effect of the various feeds upon the animal frame work.

Sales.

The animals were all sold to either the Auburn or Opelika butchers at five cents per pound live weight. If they could have been placed upon the Montgomery or New Orleans market they would have brought from six to seven and one-half cents per pound live weight. The majority of the pigs at the beginning of the test were purchased at a cost of five cents per pound, so under local conditions there was no margin of profit between the buying and the selling prices.

Values Placed Upon Feeds.

In working out the financial statement which follows, the following values were placed upon the feeds:

Corn ....70 cts. per bushel,
Cowpeas ....80 cts. per bushel,
. Cotton Seed Meal ....25 dollars per ton,
Tankage ....40 dollars per ton.

As a rule there has been no expense charged against the gains made by the hogs as a result of putting in and working the green crops. This varies so much in different localities that figures would be of very little value. But to give an approximation of what it would cost to make a pound of pork when the crops are charged against the animals the cost has been worked out for the conditions existing here upon the station farm (see table 17 page 61). It has been considered, in this bulletin, that the cost of putting in and cultivating the crop was offset by the good done the soil by having the pigs graze over it and drop the manure. This is not merely an assumption; it has been experimentally proven that where hogs on a partial ration of concentrates have been permitted to graze over an acre of green crops, that the increase yield in the cotton crop following the next year alone was 195 pounds of seed cotton, and the second year's increase, due to the grazing two years before, was 183 pounds of seed cotton.

Discussion of the Experiment.

The feeding tests here reported were conducted at different times throughout the year 1905–'06, 1906–'07, 1907–'08. With the exception of the first year the general plan was to begin the work in August or the first part of September and carry some of the lots from 35 to 50 days upon various concentrated feeds and the other lots on sorghum, as sorghum comes on earlier in the summer than do the peanuts. During the year 1907-'08 both soy beans and sorghum were used as green crops during the first period. After the first period the peanuts were ready to use and the lots were transferred from the sorghum and the soy bean pastures to the peanut pasture. The peanut pasture was exhausted in from 28 to 35 days, after which time the lots were all brought in and fed in dry lots upon concentrates only, for a finishing period of 28 days. The following tabulated statement displays the plan of the work:

TABLE 1. *General Outline of the Experiments.*

1905–6

No. Lot	Ration and Date		
	Period 1.	Period 2 (60 days) Sept. 21–Nov. 10	Period 3 (35 days) Nov. 10–Dec. 15
1		Peanut pasture Corn	Corn only
2		Peanut pasture Corn	Corn 2-3 C. S. Meal 1-3
3		Peanut pasture Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
4		Sorghum juice Cowpeas 2-3 Corn 1-3	Sorghum Juice Cowpeas 1-3 Corn 2-3
5		Cowpeas 2-3 Corn 1-3	Cowpeas 1-3 Corn 2-3
6		Corn only	Corn only

1906–7

No. Lot	Period 1 (49 days) Aug. 8–Sept 26	Period 2 (28 days) Sept. 26–Oct. 24	Period 3 (35 days) Oct. 24–Nov. 28
1	Cut sorghum Corn 2-3 C. S. Meal 1-3	Peanut pasture, Corn	Corn only
2	Grazed sorghum Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
3	Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
4	Sorghum juice Corn 2-3 C. S. Meal 1-3	Chufa pasture Corn	Japan cane Corn 2-3 C. S. Meal 1-3
5	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
6	Corn only	Corn only	Corn only

1907–8

No. Lot	Period 1 (35 days) Sept 6–Oct. 11	Period 2 (28 days) Oct. 11-Nov. 8	Period 3 (28 days) Nov. 8–Dec. 6
1	Soy bean pasture Corn	Peanut pasture, corn Corn	Corn 2-3 Tankage 1-3
2	Grazed sorghum Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
3	Grazed sorghum Corn	" " "	Corn
4	Corn 9-10 Tankage 1-10	Corn 9-10 Tankage 1-10	Corn 9-10 Tankage 1-10
5	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
6	Corn only	Corn only	Corn only

Peanut Pasture to Supplement Corn.

In all cases where peanuts were used the hogs were grazed upon them, thus saving the expense of having them harvested. This method of harvesting a crop has the additional advantage of having the manure scattered upon the cultivated fields just where wanted without the expense of hauling it with wagon and team. The data in this bulletin covers three years' work with peanuts but the first year's work is the only one during which time there was an average crops of nuts, as noted elsewhere; the crops of both the years 1906-'07 and 1907-'08 were very poor ones due to the fact that labor could not be secured to work them.

Table 2. *Summary of the three years' work with Peanuts.*

Ration	No. Animals Used	Average Daily Gains	Initial weight of pigs	Grain required for 100 lbs. gain	Cost of grain for 100 lbs. gain
		Lbs.		*Lbs.*	
Corn alone	15	.69	73	611	$7.43
Corn Peanut pasture	32	1.01	81	148 Corn .45 acre peanuts	1.85

This table, while illustrating the great use to which peanut pasture can be put in saving corn, does not deal fairly with the nuts as far as the area which is required to produce 100 pounds is concerned; as noted above, the nuts were not a full crop two of the years. Usually the area required to produce 100 pounds gain will be cut down very materally from that shown in the above table, as may be seen in a following table, in which case the peanuts were practically a full crop—or an average crop. Even though in two years out of the three there were poor stands, still the nuts made a good showing. The table indicates that .45 of an acre of peanuts was equal in feeding value to 463 pounds of corn, and that the cost of concentrates

required in making 100 pounds gain was reduced from $7.63 in the case of corn alone to $1.85 when the corn was supplemented with peanuts. In this table there has been no expense counted against the animals as a result of putting in and cultivating the green crops, as it has been experimentally proven that when a leguminous crop, like peanuts, is grown and grazed off by pigs, that the increased fertility, as measured by the succeeding year's crop of cotton, has sometimes more than paid for the expense of putting in the crop. (See page 74).

Money was lost in the case where corn alone was fed to pigs, the gains costing $7.63 per 100 pounds and could be sold for but $5.00 per 100 pounds at Auburn. Seventy cent corn calls for seven-cent hogs, live weight, if the feeder expects to come out even and realize 70 cents a bushel for corn.

The daily gains were much more satisfactory where the peanuts were grazed than when corn alone was fed. Hogs are never satisfied when fed corn alone. Corn alone does not meet the body requirements; it is lacking in protein and ash, so that when a young animal is compelled to eat corn alone he soon fails to make satisfactory gains, becomes restless, and puts in much of his time in rooting about the pen and trying to get out. A peanut-fed hog is always contented, as this feed meets the body requirements and he spends his spare time sleeping.

Bone samples have been saved from all of the animals and casual observation shows the bones of hogs which have been fed on corn alone to be much weaker and smaller than in the case where the corn was supplemented with other feeds.

During the year 1905-'06, in addition to having a peanut lot upon corn alone, there was another peanut lot which received, in addition to the peanut pasture, a two percent ration of corn and cotton seed meal, in the proportion of two-thirds corn and one-third cotton seed meal.

TABLE 3. *Corn versus Corn and Peanuts, versus Corn 2–3 plus Cotton Seed Meal 1–3.*

Ration	No. Animals used	Average Daily Gains	Initial weight of pigs	Feed required per 100 lbs. gain		Cost of grain for 100 lbs. gain
		Lbs.	*Lbs.*	*Lbs.*		
Corn alone	4	.67	65	560		$7.00
Corn				177	Corn	
Peanut pasture	8	.91	60	.12	acres peanuts	2.22
Corn 2-3,				107	Corn	
C. S. Meal 1-3	4	1.00		51	C. S. Meal	
Peanut pasture			59	.08	acre peanuts	1.97

This is the year's work when there was a normal crop of peanuts and represents more accurately what can be expected from the use of peanuts than does the preceding table. All of the lots, even the corn lots, made very satisfactory gains for such small animals. The lot upon peanuts, with corn alone added, made 35.8 per cent better gains than did the lot upon corn alone, and when both corn and cotton seed meal were added to the peanuts the gains were 47.7 per cent better than that of the corn lot. The daily gains were increased by 35.8 and 47.7 percent respectively through the addition of peanut pasture or of peanut pasture and cotton seed meal to corn alone and at the same time the cost of producing 100 pounds of pork was decreased from $7.00 in the case of corn alone to $2.22 when corn and peanut pasture were used, and to $1.97 when both corn and cotton seed meal were used in connection with the peanut pasture.

This table also illustrates the fact that when corn is worth 70 cents per bushel a farmer must secure 7 cents per pound, live weight, for his hogs if he expects to come out even when corn alone is fed.

When some cotton seed meal was added to the corn rations of the hogs when running on peanuts, the daily

gains were increased and the cost of one hundred gain was reduced from $2.22 to $1.97. No ill results followed the use of the cotton seed meal, but that is not a guarantee that evil results will never follow its use.

Tankage can be used to take the place of cotton seed meal when the farmer is afraid of losses from the use of cotton seed meal (as will be seen later), but tankage was found to be somewhat inferior to cotton seed meal for pork production.

Where corn alone was fed in addition to peanut pasture it was found that .12 of an acre of peanuts took the place of 382.5 pounds of corn, or one acre of peanuts was equal in feeding value to 56.9 bushels of corn. When both corn and cotton seed meal were fed in addition to peanut pasture one acre of peanuts was still more valuable than when corn alone was used. If the land upon which these peanuts were grown had been planted in corn instead of in peanuts it would have perhaps produced only fifteen to eighteen bushels of corn to the acre.

SORGHUM.

Sorghum is a green crop well thought of in the South as a food for swine. Its chief advantage lies in the large yields and sureness, there being very few seasons in which it fails. But it must be remembered in planning a rotation of crops that sorghum is not a legume, and that the land will not be made better on account of its having been grown. Other things being equal, a leguminous crop should generally be grown for a hog feed, on account of its beneficial effects upon the soil. This bulletin comprises two years' work with sorghum. In some cases the grain fed in connection with the sorghum consisted of corn alone, in other cases of a ration made up of corn two-thirds and cotton seed meal one-third. Only a half grain ration was fed.

In all cases the hogs were not turned into the sorghum field until the juice began to sweeten, or until some of the heads began to turn black.

A test was also made to determine whether it would be

profitable to cut the sorghum in the fields and carry it to the hogs when confined in pens.

TABLE 4. *Corn alone versus Corn and grazed Sorghum; Corn alone versus Corn 2–3 Cotton Seed Meal, 1–3 and grazed Sorghum*

Ration	No. Animals used	Average Daily Gains	Initial weight of pigs	Feed required for 100 lbs. gain		Cost of grain per 100 lbs. gain
		Lbs.	*Lbs.*	*Lbs.*		
Corn alone..	6	.78	73	456		$5.70
Corn				437	Corn	
Grazed sorghum	6	.37	73	.57	acre sorghum	5.46
Corn 2-3				206	Corn	
C. S. Meal 1-3..				103	C. S. Meal	
Grazed sorghum	6	.51	74	.37	acre sorghum	3.86

While the pigs which were confined in dry lots and fed corn alone made much better gains than can usually be expected from the use of corn alone, those animals which received the half ration of corn plus sorghum pasture, made a very poor showing, the daily gain being but .37 of a pound per pig. Another lot of pigs, not mentioned in table 4, but treated similarly to the sorghum lot, with the exception that they had soy beans in the place of sorghum, made an average daily gain of 1.02 pounds.

In the case above it is seen that .57 of an acre of sorghum took the place of but 19 pounds of corn, which means that one acre of sorghum saved but 32 pounds of corn when the sorghum was supplemented by corn alone.

A feed consisting of corn and sorghum alone is a very poor feed for either fattening hogs, or for producing growth. Both are low in protein and ash and high in carbohydrates, neither feed furnishing enough protein or ash for hogs which are not completely matured before the finishing period begins. The sorghum might have made a

better showing if the pigs used had been matured animals before the fattening period began.

When the ration of corn and sorghum was supplemented with a little cotton seed meal, as was the case with lot 3, the results were more satisfactory, but even with the use of cotton seed meal the results do not compare favorably with the results gotten from the use of either peanut or soy bean pasture as a supplement to corn. With the use of both corn and cotton seed meal 309 pounds of concentrates were required to make 100 pounds of gain, at a cost of $3.86. Data will be presented later on in the bulletin showing .37 of an acre of sorghum in lot three saved grain to the value of only $.56, or an acre of sorghum saved, in terms of concentrates, but $1.57.

In view of the fact that it is very hard work for pigs to graze sorghum, as the cane must be ridden down, and as it requires all of the hog's time—and more, too—to satisfy his appetite, since the juice is secured very slowly, it was thought that it might be profitable to place the hogs in a pen and carry the sorghum to them (soiling). Accordingly this test was tried in 1906-'07 with the following results:

Table 5. *Grazing Sorghum versus soiling Sorghum.*

Ration	No. Animals used	Average Daily Gains	Average Initial weight of pigs	Feed required per 100 lbs. gain	Cost of concentrates per 100 lbs. gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn 2-3 C. S. Meal 1-3	5	1.18	85	212 Corn 106 C. S. Meal	$3.99
Corn 2-3 C. S. Meal 1-3 Grazed sorghum	5	.43	90	314 Corn 157 C. S. Meal .15 acre sorghum	5.90
Corn 2-3 C. S. Meal 1-3 Soiled sorghum	5	.75	82	181 Corn 90 C. S. Meal .13 acre sorghum	3.39

Where a combination of corn and cotton seed meal was fed rapid and economical gains were made; this was inva-

riably the case in these experiments no matter under what conditions fed. When cotton seed meal is fed properly the hog will either make rapid gains or die. As stated elsewhere there have been no deaths during these series of tests where the hogs received a large ration of cotton seed meal, but this is no guarantee that deaths may not occur next year.

The hogs (lot 2) which grazed the sorghum down made a poor showing,—in fact the sorghum was a detriment instead of a help in this case. Where the hogs had the sorghum carried to them, (lot 3) the data show that .13 of an acre saved but $.60, or a whole acre of green sorghum after being cut and hauled to the hogs was worth but $4.61.

Under the conditions in which sorghum was fed in these experiments it was found to be almost worthless as a supplement to either corn or to a mixed ration of corn and cotton seed meal. It would no doubt be more valuable when fed to larger hogs than were used here. As used in these tests it was not found to be adapted to hogs which were being fattened. Probably one of the chief reasons why it is not a profitable hog feed is that it requires too much work on the part of the hog to extract the juice, and this work prevents the hog from laying on fat. A hog receiving only a two-per-cent grain ration and green sorghum is never satisfied; he always wants to get out of the inclosure, and when he is not trying to get out he is either chewing the cane or rooting in the ground.

Sorghum has probably one valuable place as a hog feed—to help carry the brood sows through the summer months economically when the pastures become short. Sorghum is a bulky feed and is more suited to ruminants—animals with a system of stomachs, as that of the cow and the sheep—than to the hog. The hog makes no use of the leaves and the fibrous part of the stalk at all; his stomach is too small for such bulky roughage. He eats the juice only, and much of that even is lost while he is chewing the stalk.

It should be remembered that this bulletin reports no sorghum experiments in which the plant was grazed when young; in every case the sorghum was far enough advanced so that the juice was sweet to the taste. Some farmers report success with the plant when the hogs are turned into the field when it is about one foot in height, thus inducing them to eat the tender blades along with the immature juice.

Soy Beans.

Soy beans is another leguminous crop which has proven very satisfactory as a green crop with which to supplement corn in pork production. The hogs in this experiment were turned into the field two weeks before the beans were matured sufficiently to be eaten so that for the first two weeks the swine had only the leaves and the stalks to eat, in addition to the two per cent corn ration. The hogs did not touch the beans themselves for about fifteen days after being turned into the patch. The leaves, both dead and green ones, were eaten with relish. It might have paid better to have kept the hogs off the beans until the seed were ripened sufficiently to be eaten,—that is a point open for further experimentation.

TABLE 6. *Soy bean pasture as a supplement to Corn.*

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required per 100 lbs. gain	Cost of Concentrate per 100 lbs. gain
		Lbs	*Lbs.*	*Lbs.*	
Corn alone	6	.78	73	456	$5.70
Corn .... Soy bean past'r	6	1 02	77	157 Corn .28 acres soy beans	1.96

Considering the beginning weights of the pigs, both lots made good gains, but the gains of the soy bean lot were much better than those of the corn lot. Running right by the side of the soy bean lot was a lot of pigs which were grazing sorghum, but otherwise treated the same in every

respect, yet the sorghum lot made a daily gain of only .37 of a pound.

The corn required to make an hundred pounds gain was reduced from 456 pounds in the case of corn alone to 157 pounds when the corn was supplemented by the soy bean pasture, and the cost of producing the pork was reduced in the same proportion.

It was noticed that the pigs which grazed upon the soy beans were always contented; they spent the greater part of their time in lying down. The pigs just across the fence, which were grazing the sorghum, were never contented or at rest; it could plainly be seen that they wanted something in addition to the corn and sorghum.

The above table shows that .28 of an acre of soy beans was equal to 299 pounds of corn, or an acre was equal in feeding value to, or capable of taking the place of, 19.1 bushels of corn. As noted elsewhere, the crop of soy beans was not a good one, as the beans were cut short on account of extreme drought at the time of maturing. This crop is a very economical and easy one to put in and cultivate; it is good to use it as a catch crop after oats, thus saving the ground from lying idle during the summer months, and at the same time securing a crop equal to, and in many ways superior to a corn crop. In this way, the farmer secures two crops from the same land each year, cheapens pork production very greatly, and builds up the fertility of his soil rapidly. If the soil be good much better results can be secured than reported above, as the soil upon which this crop was grown was a poor sandy one.

TABLE 7. *Sorghum pasture versus Soy Bean pasture.*

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn .... Sorghum past'r	6	.37	73	437 Corn .57 acre sorghum	$5.46
Corn .... Soy bean past'r	6	1.02	77	157 Corn .28 acre soy beans	1.96

The soy bean pasture is far above the sorghum pasture both in the daily gains made and also to the economy of the gains. The daily gains were about three times as rapid when the bean pasture was used as when the sorghum pasture was used, and the cost of making one hundred pounds of gain was reduced from $5.46 in the case of sorghum to $1.96 when soy beans were used as a supplementary pasture.

The soy bean pasture also had a much greater carrying capacity than did sorghum pasture; that is an acre of soy beans will usually carry a certain number of hogs a much longer time than will an acre of sorghum.

COWPEAS (SEED) AS FOOD FOR HOGS.

TABLE 8. *Corn alone versus Corn* 1–2 *plus Cowpeas* 1–2.

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	4	.74	63	478 Corn	$5.97
Corn 1-2 .... Cowpeas 1-2	4	.93	67	187 Corn 208 Cowpeas	5.11

Under the conditions as they existed in this test it was a profitable thing to supplement corn with cowpeas. Estimating cowpeas at 80 cents a bushel there was a saving of 86 cents for each hundred pounds of pork made through the use of the cowpeas.

Peas at the present writing (July, 1908) are not as cheap as they were in 1905–'06. Under the test as above reported peas would have been a profitable supplement to have added to the corn ration until they reached $1.05 per bushel, and then it would have been better to have fed corn alone at $.70 a bushel. When cowpeas are maintained at a high price they must be fed more sparingly than they were in this experiment.

In some previous work done at this Station* in testing the value of cowpeas as a feed for swine, one lot of hogs was fed upon a ration consisting of cowpeas alone. It was learned that when corn and cowpeas were fed separately and alone that they were practically equal in feeding value, but that when a ration was composed of one–half corn and one–half cowpeas the result due to feeding this mixture was much more satisfactory than when feeding either alone. The results were as follows:

TABLE 9. *Corn and Cowpeas separately versus Corn 1–2 plus Cowpeas 1–2.*

Ration	Average Daily Gains	Feed Required Per 100 lbs. Gain	Cost Per 100 lbs. Gain
	Lbs.	*Lbs.*	
Corn alone	.46	487	$6.09
Cowpeas alone	.59	481	6.41
Corn 1-2, Cowpeas 1-2	.62	433	5.60
Corn 1-2, Wheat brand**	.60	521	7.05

*Bulletin No. 82, 1897.
**Wheat bran valued at $30.00 per ton.

This table also points out the fact that cowpeas were very much more efficient than wheat bran as a feed for swine.

TANKAGE.

While tankage has not been used very extensively in the South as a hog feed, still it deserves a prominent place amoung the concentrated feeds which are usually brought to the feed pens from sources outside the farm. It is a by-product of the packing houses. It is very high in both ash and protein—just the two constituents in which corn is deficient—so it is an exceptionally good feed to use in conjunction with corn. It is somewhat similar to cotton seed meal in composition but has the advantage over cotton seed meal in that there is no danger in its use as a hog feed. It is a very rich feed, so should be used sparingly; in these tests it made up but one-tenth of the whole ration as a rule. The results secured through its use are tabulated below:

TABLE 10. *Corn alone versus Corn* 9–10, *Tankage* 1–10.

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	6	.60	73	574.7 Corn	$7.18
Corn 9-10 .... Tankage 1-10....	6	1.04	69	352 Corn 39.2 Tankage	5.18

The tankage and corn meal were fed together as a rather thin slop. This feed is very palatable. When corn was reinforced by the use of tankage it was found, under the conditions as they existed in this test, that 39.2 pounds of tankage were equal to, or took the place of, 222 pounds of corn. The 39.2 pounds of tankage cost $.78; the 222 pounds of corn cost $2.78; thus a saving of $2 was realized upon

each 100 pounds of pork produced by adding tankage to corn.

The test was carried on for 91 days, and it was noticed that those pigs which received corn alone made smaller and smaller gains as the experiment progressed, but the animals which received the tankage in addition to the corn made larger and larger gains as the time went on.

The corn lots would have tired of their ration long before they did had it not been for the fact that they always had all the salt, coal and lime before them that they wished to make use of.

It was thought that if the proportion of tankage were increased to more than one-tenth of the ration that enough corn might be saved to make up for the extra tankage used. This was tried in a short test where all the conditions of previous feeding favored the lot on the high proportion of tankage; that is, the lot of pigs which received the high tankage ration had just been taken off of a peanut pasture, which insured very rapid gains for at least a short time, while the lot which received the one-tenth ration of tankage had not been upon a pasture at all, but had been fed a uniform dry ration since the beginning of the test.

TABLE 11. *A one-tenth ration of Tankage versus a one-fifth ration of Tankage.*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn 9-10 .... Tankage 1-10	4	1.26	120	350 Corn 31.9 Tankage	$5.01
Corn 4-5 .... Tankage 1-5	4	1.83	142	274 Corn 67.3 Tankage	4.77

By the addition of 35.4 pounds of tankage to the ration

for each hundred pounds gain a saving of 76 pounds of corn was secured. This additional tankage cost $.71 and the value of the corn saved as a result of the addition of the tankage amounted to $.96—or a saving of $.24 on each one hundred pounds of the pork was realized. But it must be remembered that the previous management of the hogs placed the heavy tankage lot at an advantage,—how much, it is impossible to say.

As tankage is a comparatively new feed to the Alabama farmer it is appropriate to present the following table, so there can be seen at a glance its composition as compared to our more common feeds:

TABLE 12. *Average composition of some common feeds.*

Name of Feed	Dry Matter in 100 lbs.	Digestible Nutriment in 100 lbs.		
		Protein	Carbohydrates	Ether Extract
Corn	93.0	31.7	15.3	4.3
Cowpeas	91.8	37.2	16.9	1.1
Oats	89.0	9.2	47.3	4.2
Cotton seed meal	85.2	18.3	54.2	12.2
Tankage	89.4	7.8	66.7	13.6

COTTON SEED MEAL.

The deaths that sometimes occur through feeding cotton seed meal deter the majority of farmers from using it as a feed for swine. There is no Southern feed to compare with it as a supplement to corn so far as fattening and finishing is concerned. But there is a risk to run, and the man who feeds it has this risk to shoulder. During the last three years this Station has had about fifty hogs upon cotton seed meal rations fed in various proportion with corn, and extending over periods from 28 to 188 days in length. Some of the meal has been fermented and some of it has been fed unfermented. During the first two years above reported the meal was fermented twenty four hours

before being fed, then mixd with corn meal so as to make a thin slop of about the consistency of thick butter milk and given to the animals. The meal was fed sweet in 1907'08. No pigs were lost at all during the first and the last year's experimentation, but during the progress of the second year's work several pigs died that had previously been fed on fermented cotton seed meal. However, during the three years' work not a pig died *while he was actually eating* the cotton seed meal; the deaths occured immediately, or within a few days, after a lot of pigs which had been upon a ration of two-thirds corn and one-third cotton seed meal plus sorghum pasture, had been taken out and put upon a peanut pasture plus a corn ration only. That is, the deaths occured—four of them—from one to eight days after the *cotton seed meal ration had been discontinued.* The animals all died with the characteristic symptoms of cotton seed meal poisoning.

Aside from the deaths that may occur, cotton seed meal is a good feed, as will be shown later. It has even now one safe place at least in our swine feeding operations, namely, to be used in a short finishing period when hogs have been taken off of a pasture crop. The following table presents in a tabulated form the average of two year's work with cotton seed meal when both the corn lot and the cotton seed meal lot were fed without any pasture crop.

TABLE 13. *Corn alone versus Corn 2–3, Cotton Seed Meal 1–3*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	11	.65	78.5	590	$7 38
Corn 2-3 .... C. S. Meal 1-3........	11	1.00	77.	303 Corn 157 C. S. Meal	5.75

Not a pig in this particular experiment died while being fed either fresh or fermented cotton seed meal; on the other hand they made good gains, maintained their health throughout, and always had keen appetites for the next feed. Considering the size of the pigs the gains were very satisfactory when the cotton seed meal was used, and the increase in weight was made very much more economically than was the case in the corn lot. The tests show that 151 pounds of cotton seed meal are equal to, or took the place of, 287 pounds of corn; or one pound of cotton seed meal when fed in combination with corn meal in the above proportion was equal to 1.9 pounds of corn. When fed thus the cotton seed meal becomes a highly valuable and cheap feed—provided no deaths occur as a result of its use.

The above tests extended over a period of 102 days.

TABLE 14. *Corn alone versus Corn 1–3 plus Cotton Seed Meal 1–3 versus Corn 9–10 plus Tankage 1–10*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	6	.60	73	574.4 Corn	$7.18
Corn 2-3 C. S. Meal 1-3	6	1.03	69	263.8 Corn 131.9 C. S. Meal	4.95
Corn 9-10 Tankage 1-10	6	1.04	69	352.4 Corn 39.2 Tankage	5.18

In the proportion as fed above the cotton seed meal was more efficient than the tankage in saving corn, a result possibly due to the larger proportion of meal. The cotton seed meal also made 100 pounds of pork a little cheaper than did the tankage, as one hundred pounds live weight was made for $4.95 when the cotton seed meal was used,

but the same one hundred pounds increase in weight cost $5.18 when the tankage was used.

No deaths occurred in either lot, but there was some danger of deaths in the cotton seed meal lot while there was no danger at all of any deaths in the tankage lot.

There was pratically no difference between the two rations so far as daily gains were concerned, both feeds making extremely satisfactory gains.

These tests extended over a period of 91 days.

General View of Results of Three Years' Feeding Experiments.

The following table is a summary by periods of the feed fed, the average daily gains, the feed required for one hundred pounds gain, and the cost of one hundred pounds gain each year. Each period is tabulated separately. It should be noted that while this is expressed by periods that some of the lots ran through all three of the periods without a change in feed. Lots five and six during the first two years continued through all three periods without a change. Lots four, five and six were all fed in dry lots and no changes at all were made in their ration:

Table 15.—Summary of rations, gains, feed required for One Hundred pounds gain, and cost of one hundred pounds gain for the three years

1905---06

No. Lot	PERIOD I ( ) RATION	Average daily gains	Feed required per 100 lbs gain: Concentrates	Green Areas	Cost of concentrates per 100 lbs gain	PERIOD II (Sep. 21—Nov. 10, '05) RATION	Average daily gains	Feed required per 100 lbs gain: Concentrates	Green Areas	Cost of concentrates per 100 lbs gain	PERIOD III (Nov. 10—Dec. 15, '05) RATION	Average daily gains	Feed required per 100 lbs gain: Concentrates	Green Areas	Cost of concentrates per 100 lbs gain
		Lbs	Lbs	Acs	$		Lbs	Lbs	Acs			Lbs	Lbs	Acs	
1						Peanut pasture Corn	.84	191 Corn	.087	$2.88	Corn only	.71	587 Corn		$ 7.34
2						Peanut Pasture Corn	.98	164 Corn		2.05	Corn 2-3 C. S. Meal 1-3	.83	342 Corn 171 C.S.Meal		6.41
3						Peanut Pasture Corn 2-3 C. S. Meal 1-3	.99	107 Corn 53 C.S.Meal	.08 Acr	1.98	Corn Meal 2-3 C. S. Meal 1-3	.77	384 Corn 192 C.S.Meal		7.20
4						Sorghum Juice Cowpeas 2-3 Corn 1-3	1.11	207 Cowpeas 103 Corn		4.08	Sorghum juice Corn 2-3 Cowpeas 1-3	1.01	380 Corn 190 C.S.Meal	059†	7.23
5						Cowpeas 2-3 Corn 1-3	.91	264 Cowpeas 182 Corn		5.18	Corn 2-3 Cowpeas 1-3	.90	360 Corn 180 Cowpeas		6.90
6						Corn only	.67	560 Corn		7.00	Corn only	.66	554 Corn		6.92

1906—07

No. Lot	Period I (Aug. 8—Sep. 26, '06) RATION	Average daily gains	Concentrates	Green Areas	Cost	Period II (Sep. 26—Oct. 24, '06) RATION	Average daily gains	Concentrates	Green Areas	Cost	Period III (Oct. 24—Nov. 28, '06) RATION	Average daily gains	Concentrates	Green Areas	Cost
1	Soiled Sorghum Corn 2-3 C. S. Meal 1-3	.75	181 Corn 90 C.S.Meal	.18	$3 80	Peanut Pasture Corn	1.56				Corn only	1.60	578 Corn		7.16
2	Grazed Sorghum Corn 2 3 C.S.Meal 1-3	.43	314 Corn 157 C.S.Meal	.15	5 88	Peanut Pasture Corn	1 16	196 Corn	24	$ 2.48	Corn 2-3 C S Meal 1-3	1 25	221 Corn 110 C.S.Meal		4.15
3	Corn 2-3 C. S. Meal 1-3	.94	250 Corn 125 C.S.Meal		4 68	Peanut Pasture Corn	.96				Corn 2-3 C. S. Meal 1-3	.91	393 Corn 196 C.S Meal	1300 pounds Japanese Sugar Cane	7.86
4	Sorghum Juice Corn 2-3 C. S. Meal 1-3	.91	155 Corn 77 C.S.Meal	19†	2.90	Chufa Pasture Corn	.72	305 Corn	.41	3.81	Japan cane Corn 2-3 C. S. Meal 1-3	.97	206 Corn 103 C.S.Meal		3.86
5	Corn 2-3 C. S. Meal 1-3	1 18	212 Corn 106 C.S.Meal		3.97	Corn 2-3 C S Meal 1-3	.96	366 Corn 180 C.S.Meal		6 86	Corn 2-3 C. S. Meal 1-3	.54	605 Corn 302 C.S.Meal		11.88
6	Corn only	.70	488 Corn		6 08	Corn only	.80	510 Corn		6 45	Corn only	.42	1196 Corn		14 08

	1907—08														
	Period I (Sept. 6—Oct. 2, 07					Period II (Oct. 2—Nov. 8, 07)					Period III (Ncv. 8—Dec. 5, '07				
1	Soy Bean Pasture Corn	1.02	162 Corn	.28	$2.02	Peanut Pasture Corn	1.04				Corn 4-5 Tankage 1-5	1.88	871 Corn 68 Tankage		8.78
2	Grazed Sorghum Corn 2-8 C. S. Meal 1-8	.51	206 Corn 108 C.S.Meal	.87	8.86	Peanut Pasture Corn	1.14	195 Corn	.24	$ 2.25	Corn 2-8 C. S. Meal 1-8	1 88	884 Corn 117 C.S.Meal		4.89
8	Grazed Sorghum Corn	.37	886 Corn	.57	5.57	Peanut Pasture Corn	.96				Corn only	1.95	858 Corn		4.44
4	Corn 9-10 Tankage 1-10	.98	882 Corn 57 Tankage		4.89	Corn 9-10 Tankage 1-10	.98	480 Corn 48 Tankage		5.66	Corn 9-10 Tankage 1-10	1.26	854 Corn 89 Tankage		5.20
5	Corn 2-8 C. S. Meal 1-8	1.01	886 Corn 118 C.S.Meal		4.42	Corn 2-3 C.S. Meal 1-8	1.08	246 Corn 128 C.S.Meal		4.61	Corn 2-8 C. S. Meal 1-3	.91	878 Corn 189 C.S.Meal		7.09
6	Corn only	.78	462 Corn		5.77	Corn only	.58	621 Corn		7.76	Corn only	.46	888 Corn		10.47

† 490 lbs Sorghum Juice.
‡ 983 lbs Sorghum Juice.
† 485 lbs Sorghum Juice. This area represents the average for both periods. The cane from which the juice was extracted was the large Florida.

As a general thing both the rapid gains and the cheap gains were made when the hogs received some kind of pasture crop in addition to the corn. The best kind of green crops were the leguminous crops, peanuts and soy beans. As far as these experiments show, sorghum has but little value to recommend it as a green crop for finishing hogs—unless abundance of labor should permit the crop to be economically cut and hauled to the animals. Pigs when no larger than those used in these tests cannot graze it to any advantage.

Chufas proved more satisfactory than sorghum.

Table No. 15, in a way also shows the relative stands or yields of peanuts during the three years. The first year but .08 of an acre was required to make 100 pounds of gain, as against .89 of an acre for the third year, or the yield the first year was about ten times as great as that of the third year.

One acre of the various green crops carried 10 hogs (fed a half ration of concentrates) for the following length of time:

One acre of peanuts carried 10 hogs (Av. 3 years) 53 days.
One acre of sorghum carried 10 hogs (1906–'07) 153 days.*
One acre of sorghum carried 10 hogs (1907–'08) 46.6 days†.
One acre of chufas carried 10 hogs (1906–'07) 32.3 days.
One acre of soy beans carried 10 hogs (1907–'08) 34.4 days.

Since grain was fed with each crop the length of time that an acre was pastured does not indicate the relative value of an acre of the several crops.

It must be remembered that in all of the above cases the hogs received in addition to the green crop, some corn. If the corn had not been fed, of course, it would have required larger areas of green crops to get the same results. By taking an average of the three years' work it is seen that peanut pasture has a greater carrying capacity than any of the other green crops used.

*Sorghum was cut and carried to the hogs which were fed in a dry lot.
†Sorghum grazed.

Shall Hogs Which Have Been Grazed Upon Green Crops be Finished in a Dry Lot Upon Grain?

The majority of the farmers of the State who make use of green crops for fattening hogs sell the hogs directly upon the market when the crop is exhausted without finishing them upon grain for a short time in a dry lot. A study of period 3 (table 15) will throw some light upon this practice; it will help to determine whether it is profitable to feed in a dry lot for a few days upon grain alone. There are some contradictions when the three years' work are compared. The work of the first year favors selling hogs directly off the green crops; that is, the finishing period of thirty five days of dry lot feeding was a losing proposition in all cases for this year. In fact the hogs which had been fed in a dry lot throughout the entire test went through the finishing period more economically than did those hogs which had grazed peanuts for fifty days previous to the finishing period. But during the last two years' work those hogs which had been previously grazed upon a green crop made their gains in the third period more cheaply than did those which had never been given the run of a pasture crop.

During the second year's third period money was lost in the case of two lots, 1 and 3, (previously pasturing peanuts) the gains when feeding in dry lots costing from \$7.16 to \$5.39 per hundred, and these gains could be sold for only \$5.00 per hundred on the local market. If these hogs could have been put upon some of the larger markets in the South there would probably have been some profit even in these two lots. In all lots in 1907–'08, where the hogs were finished for a period of twenty eight days after taking off of peanuts, the subsequent period of dry lot feeding was found to be exceedingly profitable. During this year's work the lots which had previously been upon peanuts made unusually large gains, and made these gains economically. While the results are not all in agreement, yet they seem to indicate that it is more often profitable to finish

hogs upon dry feeds rather than to sell directly from pastures.

In all three years' work cotton seed meal was found to be a very valuable feed with which to supplement corn for finishing hogs after they had been grazed upon a green crop,—in fact the most valuable of any so far tried. That is, these finishing gains can be made more cheaply through the use of cotton seed meal combined with corn than by the use of corn alone, or corn supplemented with tankage. Cotton seed meal is an excellent feed for fattening purposes. On the average the data show that corn and cotton seed meal can be used very profitably as a short finishing feed. In other words it is usually advisable to combine corn and cotton seed meal and to dispose of some of the corn on the farm by feeding during a short finishing period, say 20 days, after the hogs have been taken off of the peanut pasture, because usually more than 70 cents a bushel can be realized upon the corn by this practice. It might not be a wise thing to keep the hogs upon this feed for as long as twenty-eight days, as deaths may occur from feeding the cotton seed meal for this length of time. In these tests no animals have died from feeding cotton seed meal for 28 days during the finishing period. It will be perfectly safe to use the cotton seed meal for at least twenty days.

There is another advantage to be gained by finishing hogs for a short period after taking them off of green crops, namely, better prices can be realized for them when placed upon the market. The hog looks better, and is actually worth more to the consumer or packer, as he is fatter and will dress out a higher per cent of good marketable meat than if he had been sold directly from the pasture. The corn-fed hog has a decided advantage in all the Southern markets.

In this connection the point should not be overlooked how extremely expensive the gains become along about the last month of feeding when hogs are being fattened upon corn alone, running from $7.00 a hundred in one case to

about $15.00 per hundred increase in live weight in another case.

When hogs have been grazed upon peanuts, and certain other green pastures, there is yet another advantage to be gained in feeding them upon dry feeds a short time before selling. It is well known that peanuts soften the meat very much, so that it is not as acceptable to many butchers and to the packers as the animals that have been fed upon grain alone. This soft meat can be hardened very materially, if the hogs are fed upon grains only for a short period after the peanuts are exhausted. Corn is good; corn in combination with cotton seed meal is better than corn alone, as the addition of some cotton seed meal to the ration renders the meat hard more rapidly than when corn alone is used.

Summary of Average Results for Three Years.

In table number sixteen is brought together the summary, or average, of the experimental work for three years.

The average shows that large gains and cheap gains go with the use of green crops and that the best green crops are the legumes. The table also demonstrates strikingly that small gains and the high priced gains go with the use of corn exclusively. Every supplement used with corn cheapened the gains, no matter whether it was a pasture supplement or another concentrate—except when the cost of putting in and cultivating the crops was charged against the gains, when sorghum and chufa pastures were found to be of no advantage.

In comparing lots 2 and 3 there seems to be an apparent contradiction to the data presented heretofore; that is table No. 14 taught that cotton seed meal produced gains more economically than did the tankage, while in this table the cheaper gains seem to have been made with tankage. This is due to the fact that the data for lot 2 in the present table are a summary of two years' work, while in table 14 only the last year's test was used, so that a direct comparison could be made between the cotton seed

Table 16. Average total summary of **1905–'06; 1906–'07; 1907–'08.†**

No. Lot	Ration	No. Pigs in Test	Average Daily Gains	Feed Required Per 100 lbs. Gain: Concentrates	Feed Required Per 100 lbs. Gain: Pasture Areas	Cost of Concentrates Per 100 lbs. Gain
			Lbs	*Lbs.*	*Acre*	
1	Corn only	15	.69	611 Corn		$7.63
2	Corn 2-3 ... C. S. Meal 1-3 ..	11	1.04	303 Corn 157 C. S. Meal		5.75
3	Corn 9-10 ... Tankage 1-10...	6	1.04	352 Corn 38 Tankage		5.18
4	Corn 1-2 ... Cowpeas 1-2 ...	4	.94	187 Corn 207 Cowpeas		5.11
5	*Corn ... Peanut pasture	32	1.01	183 Corn	.44	2.28
6	*Corn Meal 2-3 C. S. Meal 1-3... Peanut pasture	4	1.00	107 Corn 51 C. S. Meal	.08	1.97
7	Corn ... Sorghum past'r	6	.37	437 Corn	.57	5.36
8	Corn 2-3 ... C. S. Meal 1-3... Sorghum past'r	11	.46	259 Corn 129 C. S. Meal	.26	4 85
9	Corn ... Chufa pasture..	3	.72	305 Corn	.41	3.81
10	Corn ... Soy bean past'r	6	1.02	158 Corn	.28	1.96
11	Corn Meal 2-3... C. S. Meal 1-3 .. Soiled sorghum	5	.75	181 Corn 90 C. S. Meal	.13	3.39

*Lots 5 and 6 are not comparable. It would seem, on the face, that the addition of cotton seed meal to the corn and peanut ration worked wonders, but this cannot be compared to lot 5 as lot 5 takes in all the years, (and the last two years had very poor stands), while the data in lot 6 were obtained only in 1905 when the stand of peanuts was extra good.

†Cost of putting in and cultivating the pasture crops not taken into consideration.

meal and the tankage. Table 14 is more reliable on this single point than the present table.

The results from the use of the chufa pasture has not been discussed so far, as so few animals were used that any conclusions drawn could not be relied upon absolutely. But, looking at lot 9, it is seen that the daily gains made upon the chufa pasture, while not as good as those made upon soy bean and peanut pastures, are much better than those made when sorghum was used. It is also seen that the chufa pasture saved corn.

Cost of Gains When Manural Value and Expense of Putting in and Cultivating the Crops are Considered.

In the above table there has been no expense charged against the hogs on account of putting in and cultivating the pasture crops. Neither has there been any credit given to the soil by reason of there having been grown upon it leguminous crops. The manure dropped by the animals while grazing the crops has not been credited to the soil.

Of course there is no figure which will express the exact cost of putting in a crop under all conditions, as conditions vary with different localities. Neither are there any exact figures to tell just how much good will come to the soil as a result of growing a leguminous crop; this varies with different soils and with many other conditions. So the following estimate is based upon the approximate average cost of putting in crops upon the Station farm, and the fertilizing value of a leguminous crop is based upon work done here and reported in previous bulletins.

The cost of putting in and cultivating each acre of the various crops, counting labor at eighty cents a day and one man with one mule at one dollar a day, was approximately as follows:

PEANUTS:

To one bushel seed	$ 1.90
To commercial fertilizer	1.50

To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	1.00
To cultivating three times	1.20
To hoeing one time	.80
To rent or interest	2.00
Total cost of each acre	$9.60
By assumed increase in next year's crop due to fertilizer effect of peanuts and grain fed (partly based on Alabama Bulletins 120 and 137)	$ 7.50
Net cost of one acre peanuts	$ 2.10

SOY BEANS:

To one bushel seed	$ 2.20
To commercial fertilizer	1.50
To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	1.00
To cultivating four times	1.60
To hoeing one time	.80
To rent or interest	2.00
Total cost of each acre	$10.30
By assumed increase in next year's crop due to fertilizing effect of peanuts and grain fed	$ 7.50
Net cost one acre soy beans	$ 2.80

SORGHUM:

To one-half bushel seed	$ .75
To commercial fertilizer	5.00
To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	.75
To cultivating four times	1.60
To rent or interest on land	2.00
Total cost of each acre	$11.30

(No credit for soil improvement)

CHUFAS:

To one peck of seed	$ 1.00
To commercial fertilizer	5.00
To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	1.00
To cultivating four times	1.60
To hoeing one time	.80
To rent or interest on land	2.00
Total cost of each acre chufas	$12.60

(No credit for soil improvements).

Counting the expense of putting in and cultivating the green crops as above, the cost of making one hundred pounds gain on the hogs in each one of the lots was as follows:

TABLE 17.

Lot 1	Corn alone	$ 7.63
Lot 2	C. S. Meal 1-3 Corn 2-3	5.75
Lot 3	Corn 9-10 Tankage 1-10	†5.18
Lot 4	Corn 1-2 Cowpeas 1-2	5.11
Lot 5	Corn Peanut pasture	*3.20
Lot 6	Corn 2-3 C. S. Meal 1-3 Peanut pasture	*2.14
Lot 7	Corn Sorghum pasture	11.90
Lot 8	Corn 2-3 C. S. Meal 1-3 Sorghum pasture	†7.79
Lot 9	Corn Chufa pasture	†8.98
Lot 10	Corn Soy Beans	2.74
Lot 11	Corn 2-3 C. S. Meal 1-3 Soiled sorghum	†4.86

When all expenses are *charged against putting in these green crops,* it is seen that sorghum makes a very poor showing, even inferior to corn when fed alone. Looked at from every point of view it seems that mature sorghum (pastured) has no place as a feed for finishing swine. It seems that it might, under certain conditions where labor can be contracted and secured cheaply, be a profitable

*Lots 5 and 6 not to be compared; see foot note to Table 16.
†Data for one year only.

thing to grow sorghum and cut it when ripe and carry it to the hogs. In lot II, where it was so handled economical gains were made; but the labor of cutting the sorghum and carrying it to the hogs has not been included in the estimate. The hogs made very much more economical use of the sorghum as far as the sorghum itself was concerned, when it was cut and fed to them in a dry lot than when they were permitted to graze it, that is, the waste was not so great in soiling sorghum.

The chufa pasture also made a very poor showing, but the gains were somewhat cheaper than when the sorghum pasture was used. Neither sorghum nor chufas are legumes.

The greatest profits were made when a leguminous crop was used to supplement the corn. In fact, in all cases where either peanuts or soy beans were used profits were realized even if no credit be given for the improvement of the soil. The results in lot 6 more nearly represents what the farmer can expect from the use of peanuts than those with lot 5, as lot 6 represents only one year's experiment, when there was a good stand of the nuts, while lot 5 is an average of all the three years' work, which includes two years of very poor crops.

TABLE 18. *Financial Statement.* (*Summary* 1905–'06 1906–'07, 1907–'08.) ††

No. Lot	Ration	No. Pigs Used	Initial Cost of Whole Lot	Cost of Grain Given each Lot	Total Cost of the Hogs Plus the Concentrates	Selling Price Whole Lot at 5 cts per lb.	Profit on Whole Lot	Profit Per Pig After Charging Corn Against them at 70 cts per bu.	Price Actually Realized for each Bu. Corn
1	Corn only........	15	$ 56.30	$59.60	$111.50	$ 97.90	$—18.00	$—1.20	$ .48
2	Corn 2-3 .... C. S. Meal 1-3..	11	42.20	54.15	96.35	90.65	— 5.70	— .51	.59
3	Corn 9-10 .... Tankage 1-10..	6	20.85	24.49	45.35	44.35	— .99	— .16	.66
4	Corn 1-2.. .... Cowpeas 1-2	4	13.50	16.13	29.63	27.00	— 2.63	— .65	.47
5	Corn .... Peanut past'r..	32	142.20	26.10	168.20	199.00	30.80	.96	†1.53
6	Corn 2-3 .... C. S. Meal 1-3 Peannt past'r..	4	11.85	3.95	15.80	21.80	6.00	1.50	†2.30
7	Corn .... Graz'd sorgh'm	6	21 95	4.26	26.21	25.85	.36	.06	.64
8	Corn 2-3 . . ... C. S. Meal 1-3 Graz'd sorgh'm	11	45.00	10.46	55.46	55.75	.29	.03	72
9	Corn .... Chufa past'r...	3	16.40	2.33	18.73	20.05	1.32	.44	1.10
10	Corn .... Soy bean past'r	6	23.20	4.26	27.46	34.00	6.54	1.09	1.80
11	Corn 2-3 .... C. S. Meal 1-3 Soiled sorgh'm	5	20.70	5.05	25.75	30.00	4.25	.85	*1.58

*Labor of cutting and hauling is not included.
‡And the other feeds as ffuoted on page 6.
†Lots 5 and 6 are not comparable; see note to Table 16.
††Taking no account of the cost of growing the pasture crops.

From the financial statement in table 18 it is seen that when corn is worth 70 cents a bushel, cotton seed meal $25.00 per ton, tankage $40.00 a ton, and cowpeas 80 cents a bushel, some of the lots made good profits, while other lots were fed at a financial loss. That is, some of the lots of hogs returned more than the market price for the feeds used while some of the lots did not make gains economical–

ly enough so that the usual market prices for corn and the other grains used could be realized. By the use of certain combinations of feeds it was a very profitable thing to do to dispose of the corn by means of feeding hogs; more was made by thus disposing of it than if it had been sold directly upon the market at 70 cents a bushel; when the corn was fed incorrectly, or not judiciously, money was lost by feeding it to the hogs.

Lot 1, the corn lot, made the greatest loss of any of the pens; lot 6 made the largest profits. The corn lot lost $1.20 per pig. This was a very heavy loss for the pigs weighed but 130 pounds each. From a financial standpoint it proved to be advisable to supplament the corn ration with cotton seed meal and tankage.

The ration of corn one-half plus cowpeas one-half was not as profitable as when corn was supplemented with the cotton seed meal or tankage, there being a loss upon each pig of $.65 when fed on cowpeas and corn. It is but fair to state that under present conditions, and in fact since 1905, the financial showing in lot 4, where corn and cowpeas were fed would not be as good as the above data represent, for when the test was made the cowpeas were purchased for 80 cents a bushel, and have been so figured in the financial statement, but it has been impossible to purchase them for the above price since that date.

Where pasture crops were used in combination with grain good profits were made possible—that is, more than 70 cents a bushel was realized upon corn from the feeding operations. This last table does not include the cost of putting in and cultivating the green crops, neither does it take into consideration the value to the land in having the pigs graze upon it. But if the manurial value be eliminated altogether and the pigs be charged with the cost of putting in and tending the crops it is still found that excellent profits were made when peanuts and soy bean pastures were used, but when chufa and sorghum pastures were used money was lost. The legumes made the best showing by far. In fact, when the cost of putting in the crops is

charged against the hogs the sorghum lots lost more money than did the lots upon corn alone.

This table again emphasizes the fact that money cannot be made by finishing hogs through the use of corn alone. The farmer cannot expect to sell his corn for 70 cents a bushel through hogs when the hogs have nothing else to eat except the corn—that is, he cannot do it when the hogs sell at five cents per pound live weight. The farmer could not afford to feed corn alone, no matter how high hogs might sell, for much more could be made out of the corn by combining it with some other feeds, either green or concentrated.

The last column in table 18 brings out some valuable points; here we find tabulated the prices which were obtained for each bushel of corn fed. In lot 1, where corn alone was fed, but $.48 per bushel was realized by feeding the corn to the hogs. When corn was supplemented with cotton seed meal and tankage the corn was sold through the hogs for $.59 and $.66 respectively. That is, through feeding tankage with corn the value of the corn was increased 18 cents a bushel. The greatest value was gotten from the corn when it was fed in connection with the leguminous crops, peanuts and soy beans; in these cases the prices received for the corn varied from $1.53 per bushel up to $1.80 per bushel. Much more was made out of the corn when it was fed in connection with a leguminous crop than would have been made had it been sold directly upon the market.

Profits Realized When Hogs Were Sold at Varying Prices.

The preceding table represents the profits and losses just as they actually occured at Auburn under the local market conditions. The hogs were bought for 5 cents a pound live weight and sold for 5 cents, upon the local market after being fed for from 84 to 112 days. If the hogs could have been placed upon Montgomery, Mobile, Birmingham, or New Orleans markets they would have

brought from 6 to 7 1–2 cents per pound on foot. So to illustrate what would have been made or lost under these varying conditions the following table is attached:

TABLE 19. *Profits realized when hogs are sold at various prices.*†

No. Lot	Ration	Profits per Pig when bought at 5c per lb. and sold at:- (after feeding from 84-112 days)					
		5 cts.	5½ cts.	6 cts.	6½ cts.	7 cts.	7½ cts.
1	Corn alone	—1.20	$—.55	$ .11	$ .75	$1.41	$2.06
2	Corn 2-3 .... C. S. Meal 1-3.......	—.51	.31	1.13	1.95	2.78	3.60
3	Corn 9-10 .... Tankage 1-10	—.16	.57	1.32	2.05	2.79	3.53
4	Corn 1-2 .... Cowpeas 1-2	—.65	.02	.69	1.33	2.04	2.72
*5	Corn .... Peanut pasture	.96	1.58	2.21	2.83	3.45	4.07
*6	Corn 2-3 .... C. S Meal 1-3........ Peanut pasture	1.50	2.04	2.58	3.12	3.66	4.20
7	Corn .... Grazed sorghum	.06	.48	.92	1.35	1.78	2.21
8	Corn 2-3 .... C. S. Meal 1-3........ Grazed sorghum	.04	.54	1.04	1.58	2.12	2.62
9	Corn .... Chufa pasture	.44	1.10	1.76	2.42	3.08	3.76
10	Corn .... Soy bean pasture.....	1.09	1.65	2.21	2.77	3.33	3.89
11	Corn 2-3 .... C. S. Meal 1-3........ Soiled sorghum	.85	1.45	2.05	2.65	3.30	3.95

†Cost of putting in crop not taken into account.
*Lots 5 and 6 are not comparable.

TABLE 20. *Prices realized upon each bushel of corn when hogs were sold at various prices.*

No. Lot	Ration	Price Actually Realized for Corn per Bushel when the Hogs were bought at 5 cts. and sold at					
		5 cts.	5½ cts.	6 cts.	6½ cts.	7 cts.	7½ cts.
1	Corn alone	$ .48	$ .60	$ .72	$ .84	$ .96	1.08
2	Corn 2-3 .... C. S. Meal 1-3........	.59	.77	.95	1.13	1.38	1.49
3	Corn 9-10 .... Tankage 1-10	.66	.77	.88	.99	1.10	1.21
4	Corn 1-2 .... Cowpeas 1-2	.47	.71	.95	1.19	1.43	1.67
*5	Corn .... Peanut pasture	1.53	2.03	2.53	3.03	3.53	4.03
*6	Corn 2-3 .... C. S. Meal 1-3........ Peanut pasture	2.33	2.92	3.51	4.10	4.65	5.28
7	Corn 2-3 .... Sorghum pasture	.64	1.06	1.48	1.90	2.32	2.74
8	Corn 2-3 .... C. S. Meal 1-3 ...... Sorghum pasture	.72	1.28	1.48	2.40	2.96	3.52
9	Corn .... Chufa pasture	1.10	1.71	2.32	2.93	3.54	4.15
10	Corn .... Soy bean pasture	1.80	2.36	2.93	3.48	4.04	4.60
11	Corn 2-3 .... C. S. Meal 1-3........ Soiled sorghum	1.58	2.20	2.82	3.44	4.06	4.68

*Lots 5 and 6 are not comparable.
†Cost green crop not considered.

If the hogs could have been sold at 6 cents a pound instead of at 5 cents a pound, every lot, even the corn lot would have been fed at a profit. Even when sold at 5 1-2

cents a pound all lots except the corn lot were profitably fed.

In these tests when the hogs were bought at five cents per pound and fattened and sold at five cents per pound, but 48 cents was realized per bushel for corn when corn was fed alone. This is about 22 cents a bushel less than could be secured for the corn if it had been sold directly upon the market. But when pigs were bought at five cents a pound and sold at seven cents a pound 96 cents was realized upon each bushel of corn even when nothing but corn alone was used.

But in every case where corn was fed in combination with some other feed a better price was secured for the corn, when neither the manurial value nor the cost of putting in the crop were considered; that is, corn was made more efficient by the addition of the various supplements. For instance in lot 5, where peanut pasturage was the supplement, $1.53 was realized upon each bushel of corn (not counting cost of pasture crops) when hogs were bought at five cents and sold at the same price, and $3.53 was realized upon each bushel of corn when they were bought at five cents and sold at seven cents per pound live weight.

This table brings out the point distinctly that when hogs sell as they have been selling in the South for the last few years that the farmer cannot afford to sell his corn upon the market at 70 cents per bushel, or even at $1.00 per bushel. The best and most profitable way to sell corn is to combine it with some other feed and sell it through hogs or some other live stock.

Slaughter Data.

In many parts of the State the local butchers quote the dressed weights of the hogs two cents higher than the live weight. For instance upon the Auburn market for the last three years the farmers have been given the choice of selling their hogs either at 5 cents a pound live weight or 7 cents a pound dressed weight. These quotations have stood inflexible, no reference at all being made to either

the degree of fatness or to the conformation or type of the animals offered.

TABLE 21. *Should the farmer sell his hogs at five cents live weight or seven cents dressed weight?*

Ration	No. Pigs	Average Live Weight at Killing Time	Average Dressed Weight	Per Cent. Dressed Weight to Live Weight	Value each Pig at 5 cts. Live Weight	Value each Pig at 7 cts Dressed Weight
Corn only	12	131	96	73.28	$6.50	$6.72
Corn 2-3 C. S. Meal 1-3	9	181	130	71.82	9.05	9.10
Corn 9-10 Tankage 1-10	5	158	116	73.42	7.90	8.12
Corn Peanut pasture	5	131	100	76.33	6.55	6.00

While the above table does not include all the data that has been collected from the slaughtered animals, sufficient facts are presented to bring out the point that when hogs are fat enough to kill out about 72 per cent dressed weight that it makes pratically no difference whether they are sold at 5 cents a pound live weight or 7 cents a pound dressed weight. This table does not take into consideration the expense of killing the hog, which must be charged against the hog when he is delivered dressed, neither does it take into account the value of the internal fat and the other organs which go to the farmer when the contract calls for dressed animals. In most instances the value of the internal organs will just about pay for the expense of killing.

The point is brought out that when a hog is excessively fat, which means that he will dress about 80 per cent, it is more profitable to the farmer to sell him at 7 cents dressed weight than to sell him at 5 cents live weight. It would,

of course, be more profitable from the butcher's stand-point to buy him on the basis of live weight. That is, the fatter the hog the greater should be the difference between the live weight and the dressed weight quotations, so that all parties concerned may be treated with fairness.

Then, on the other hand, the type of hog, which is represented by the razor back, the small hammed, narrow backed, long legged kind, will lose the owner more money when they are sold at 7 cents dressed weight than when they are sold at 5 cents a pound live weight, because this type dresses out a small proportion of saleable parts. That is, the nearer the hog comes to representing the razor back type the smaller should the net quotations be over the live weight quotations.

The butcher who does not take these things into consideration is not treating his customers fairly. The man who raises hogs of correct type and takes pride in finishing them to prime condition is being discriminated against when the butcher has an arbitrary price like the above. Before a just value can be placed upon a bunch of hogs they must be seen, so that both type and the degree of fatness can be taken into consideration.

Some General Considerations in Swine Production.

It is sometimes claimed that pork production cannot be made a profitable business in the South since corn has advanced in prices. It is often said that the farmer can buy his pork cheaper than he can make it. But is must be remembered that pork has advanced in price as well as corn, that the cheapest side meat now costs from 10 to 12.5 cents a pound, and that hams and shoulders cost from 15 to 20 cents a pound. Corn has advanced in price more rapidly than has pork, but the South is in a position to change her feeding methods when corn, as a sole feed, gets out of reach. The Southern hog prices are higher than at either the St. Louis or Chicago markets. At the present writing, prices all over the South are substantially higher than they

are in Chicago. All conditions here are encouraging for hog production; we can grow the corn, we have the best markets, as far as prices are concerned, in America; and we can grow many kinds of pasture crops, the crops which cheapen pork production more than any other feed.

It is generally considered that there is no other feed equal to corn for pork production,—this is true, provided the corn is used judiciously. If it be fed alone for any length of time there are few feeds which are poorer than corn, as the preceding experiments strikingly demonstrate, but if it be fed in combination with other feeds its use is to be highly commended, and it can be used to great economical advantage, too, even though it sells upon the market for 70 cents a bushel.

The hog is not adapted to living on corn alone, and when we require it of him we are forcing him to do a thing which is not consistent with his nature. Man likes a mixture of feeds or a change in diet; so do the lower animals. The hog in its wild state is not compelled to live upon one feed alone. When wild and free to make its own choice he is omniverous, feeding upon roots, nuts, fish, grass, fruit, snakes, and in fact, but few feeds can be mentioned that he will not eat if he be given the opportunity. Our domesticated hogs have inherited the tendency to select their foods from a variety of substances, and when we enclose them in a pen and feed but one feed we can feel assured that we are not allowing them to reach their highest possibilities.

Probably those who claim that pork cannot be produced in the South at a profit mean that it cannot be produced on corn alone at a profit; if so, that is entirely correct. Experimental data show that pork cannot be profitably raised and finished upon corn alone when corn sells for 70 cents a bushel. The following table, made up from data collected from all parts of the United States, clearly demonstrates the fact that the man who tries to finish hogs on corn alone is following a losing business;

Table 22. Corn alone for fattening hogs.

Station	No. Pigs	Length Exp.	Average Daily Gains	Lbs. Feed to make 100 lbs. Gain	Cost 100 lbs. gain when Corn is:— 40 cts.	50 cts.	60 cts.	70 cts.
		Days	*Lbs.*					
Texas	10	83	.46	762	$ 5.44	$ 6.80	$ 8.15	$ 9.52
Texas	10	83	.43	868	6.20	7.75	9.30	10.85
Tennessee	3	60	1.00	460	3.88	4.10	4.93	5.75
Tennessee ...	3	60	1.00	416	2.97	3.72	4.46	5.20
Tennessee	7	......	.50	410	2.93	3.6[illegible]	4.39	5.12
Alabama	3	60	......	806	5.76	7.20	8.63	10.07
Alabama	3	35	......	670	4.79	5.98	7.18	8.37
Alabama	3	56	.40	621	4.43	5.54	6.65	7.76
Alabama	15	96	.69	611	4.36	5.45	6.55	7.64
Indiana	3	70	1.06	432	3.09	3.86	4.63	5.40
Indiana	4	127	.67	520	3.72	4.65	5.57	6.50
Oklahoma	4	126	.62	470	3.36	4.19	5.03	5.87
Iowa	6	49	2.08	461	3.29	4.12	4.95	5.74
Wis. (4 trials)..	[illegible]	......	1.09	459	3.28	4.09	4.87	5.74
Wis. (4 trials)..	35	......	1.41	499	3.57	4.45	5.35	6.24
Average			......	564	4.01	5.4	6.04	7.02

The average farmer under ordinary conditions will not miss the average far. And the average of the preceeding table points out the fact that when corn is worth 70 cents a bushel that the cost of each pound of gain will be just about 7 cents, when corn is selling at 60 cents a bushel each pound of gain put on will cost 6 cents, when corn is worth 50 cents a bushel each pound of gain will cost 5 cents, and when corn is worth only 40 cents a bushel pork can be made for only 4 cents a pound. The table shows that when 70–cent corn is fed to 5–cent hogs that the feeder is losing 20 cents per bushel on his corn. To come out even in Alabama 70–cent corn must go along with 7–cent pork if the owner is to strike even on feeding corn alone. As a general thing the farmers do not get 7 cents for their hogs. If corn were worth but $.40 per bushel, as it is in some of the Western States, it would be a very profitable thing to raise corn and feed it to 5 and 6–cent hogs; good

money could be made out of it, as the farmer would then be selling his \$.40 corn by means of hogs at from \$.50 to \$.60 per bushel. But even in the corn belt States it is more profitable to supplement the corn with other concentrates or green crops,—a practice followed by the best Northern farmers.

The data recorded in this bulletin point the way to cheaper pork production in Alabama. If we are to make the most that there is to be made from pork, and at the same time build up and maintain our soils, we must make a liberal use of green crops. Alabama can grow green crops almost the year round as indicated by the following table:

Table 23. Succession of green crops suitable for hog grazing:

For fall planting.

Crop	Time to Plant	Amount Seed Per Acre	No. days from planting time until grazing time
Alfafa	Sep't. 1 to Oct. 15	15 to 25 lbs.	90 to 120
Burr clover	Sep't. 1 to Oct. 1	15 to 20 lbs. cleaned seed 36 lbs. in burr	90 to 120
Oats	Sep't. 1 to Nov. 1	1½ to 3 bu.	90 to 120
Rape	Sep't. 20 to Oct. 15	4to 6 lbs. drilled 5 to 10 lbs. broadcast	60 to 75
Rye	Sep't. 1 to Nov. 1	1½ to 2 bus.	90 to 120
Vetch	Sep't. 1 to Oct. 15	1 bu.	90 to 120

For spring and summer planting.

Crop	Time to Plant	Amount Seed Per Acre	No. days from planting time until grazing time
Alfafa	Feb. 25 to April 1	15 to 25 lbs.	75 to 90
Chufas	Mar. 15 to June 1	3 to 4 pks.	120 to 150
Cowpeas	May 1 to July 10	½ bu. drilled 1½ bu. broadcast	75 to 90
Japan clover	Mar. 1 to Mar. 15	24 lbs.	60 to 75
Oats	Feb. 1 to Mar. 20	1½ to 3 bus.	75 to 90
Peanuts	May 1 to June 30	1 to 2 bu. unhulled	90 to 120
Rape	Mar. 1 to Mar. 31	4 to 6 lbs. drilled 9 to 10 lbs. broadcast	60 to 75
Sorgum	April 1 to June 30	1½ to 2 bus.	60 to 90
Soy beans	April 1 to June 30	½ bu, drilled 1½ bu. broadcast	90 to 120

Through the use of these crops the expense of carrying the brood sows and boars through the year can also be

greatly reduced. Many of these crops would keep the sows in a fat condition without the use of any grain at all,—and it is the grain that costs the money in Alabama.

Another point is too often overlooked, but is of great moment to Southern soil maintenance, and should be considered in all cases where live stock is handled—the relation of live stock to soil fertility. The farmer who keeps live stock has a fertilizer factory upon his own farm. Stock will improve the soil to such an extent that poor soils can within a few years be made to produce a bale of cotton to the acre.

Producing hogs is an excellent method by which soils can be maintained and built up. In 1898 the Arkansas Station grazed hogs upon areas of peanuts, chufas, and soy beans. The two years following 1898 the land was planted in cotton and data was collected to determine what effect this grazing might have upon cotton yields. The results per acre were as follows:

Table 24. Fertilizing effect of crops grazed by hogs:

	Seed Cotton 1899	Seed Cotton 1900	Average yield seed cotton 1889-1900	Average per cent. increase in seed cotton due to grazing and growing the crop	Value of increase per acre each year (lint 11c. seed 60c)
Cotton following peanuts grazed by hogs.........	1771	1134	1452.5	61.1	$23.81
Cotton following soy beans grazed by hogs.......	1588	1020	1304.0	44.6	16.35
Cotton following chufas grazed by hogs	1200	981	1090.	20.9	7.63
Cotton following corn not grazed	1005	798	901.5	....	......

The effect upon the soil of growing a legume and then grazing it off with hogs is remarkable; for instance in the case of soy beans and peanuts the increased yield of cotton was 44.6 per cent and 61.1 per cent respectively. The

effects of growing these crops and grazing them off does not stop with the cotton crop grown the first year following the grazing; the data show that the increase over the corn lot was still considerable in the second year.

Of course, in the case where peanuts and soy beans were used the increased cotton yields were not due entirely to the grazing; part of the benefits were due to the fact that the crops were legumes, thus placing nitrogen in the soil for the use of subsequent crops. But with chufa pasture we have a case in hand where the increased cotton yields could have been due to nothing except the grazing and the supplementary grain fed, as the chufa plant is not a legume. In this case the increased cotton yields for the average of the two years following the chufas, which had been grazed off, was 20.9 per cent over the cotton crops which had followed a corn crop without being grazed off by the hogs. That is, a farmer can expect to get more cotton when it is planted on an area where hogs have grazed or where peanuts, soy beans, or other legumes have been grown than he can secure from an area where hogs have not been grazed.

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN.

THE SAN JOSE SCALE AND LIME-SULFUR WASH

BY

W. E. HINDS,

Entomologist

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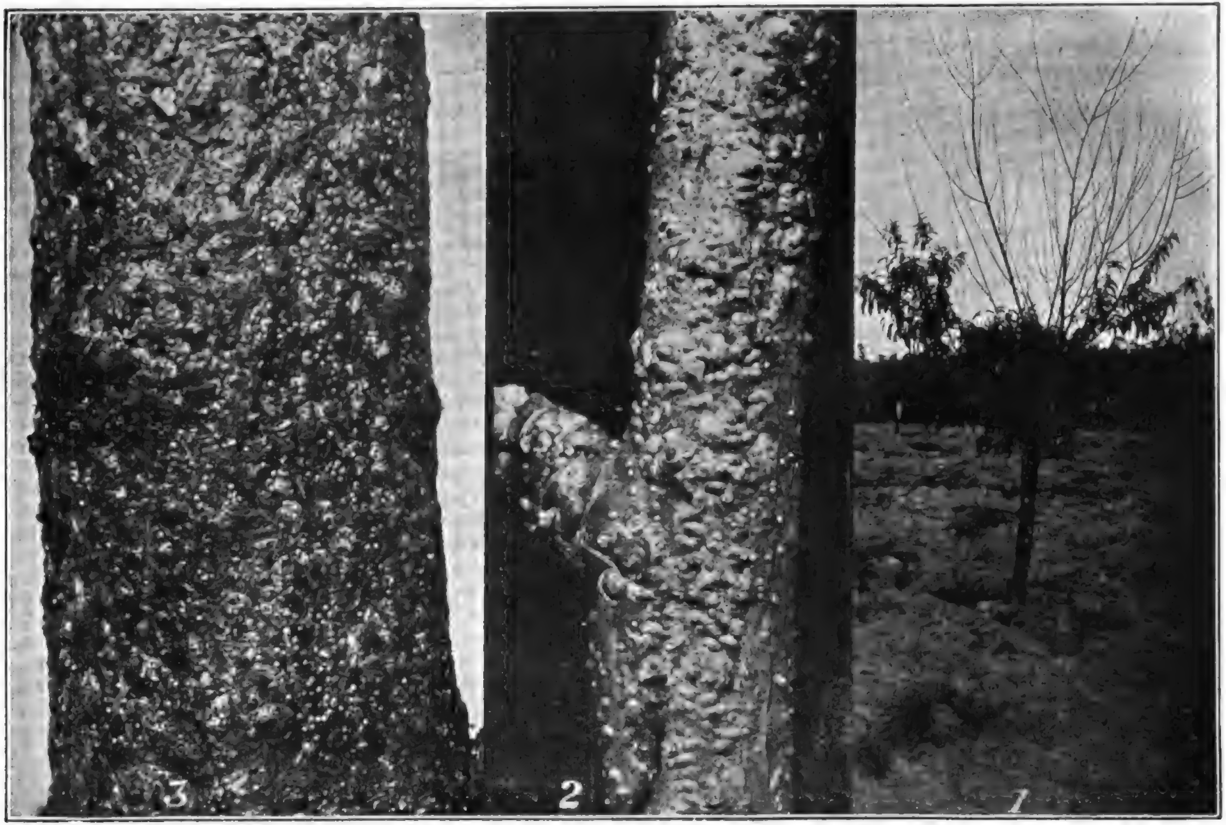
PLATE I.



THE SAN JOSE SCALE AND ITS WORK.

[Fig. 1.—Peach tree with top killed by the scale. Fig. 2.—Peach twig moderately infested, showing male and female scale.

THE SAN JOSE SCALE AND LIME-SULFUR WASH

BY

W. E. HINDS, PH. D.
Entomologist to Alabama Experiment Station.

ORCHARD INTERESTS OF ALABAMA.—The culture of orchard fruits, particularly peach, plum, pear and apple, is already a very important factor in the agricultural prosperity of Alabama. As nearly as we are able to estimate from the data available there are about 8,000,000 trees of these four kinds now growing in this State. Soil climate and market conditions are exceedingly favorable to a large increase in the growth of these fruits. The extension of the present important movement for the production of a greater diversity of crops, the substitution of other, and more profitable, crops for cotton and the adoption of improved methods for the culture of all crops grown will undoubtedly result in a great increase in fruit growing within the next few years. The growth of these fruits for wholesale commercial shipments and for the supply of the home markets as well, should increase largely as a profitable business proposition.

DANGER FROM SAN JOSE SCALE.—The principal difficulty to be met in maintaining present and in increasing future fruit culture is the necessity for controlling the insect enemies which, if left uncontrolled, may partially, or entirely, destroy the crops of fruit or even the life of the trees themselves. The most important insect affecting the four species of trees mentioned is the San Jose scale (pronounced "San Hosay") known scientifically as *Aspidiotus perniciosus* Comst. This is the most deadly enemy of fruit-growing known. The name itself means "most injurious scale" and it was well chosen.

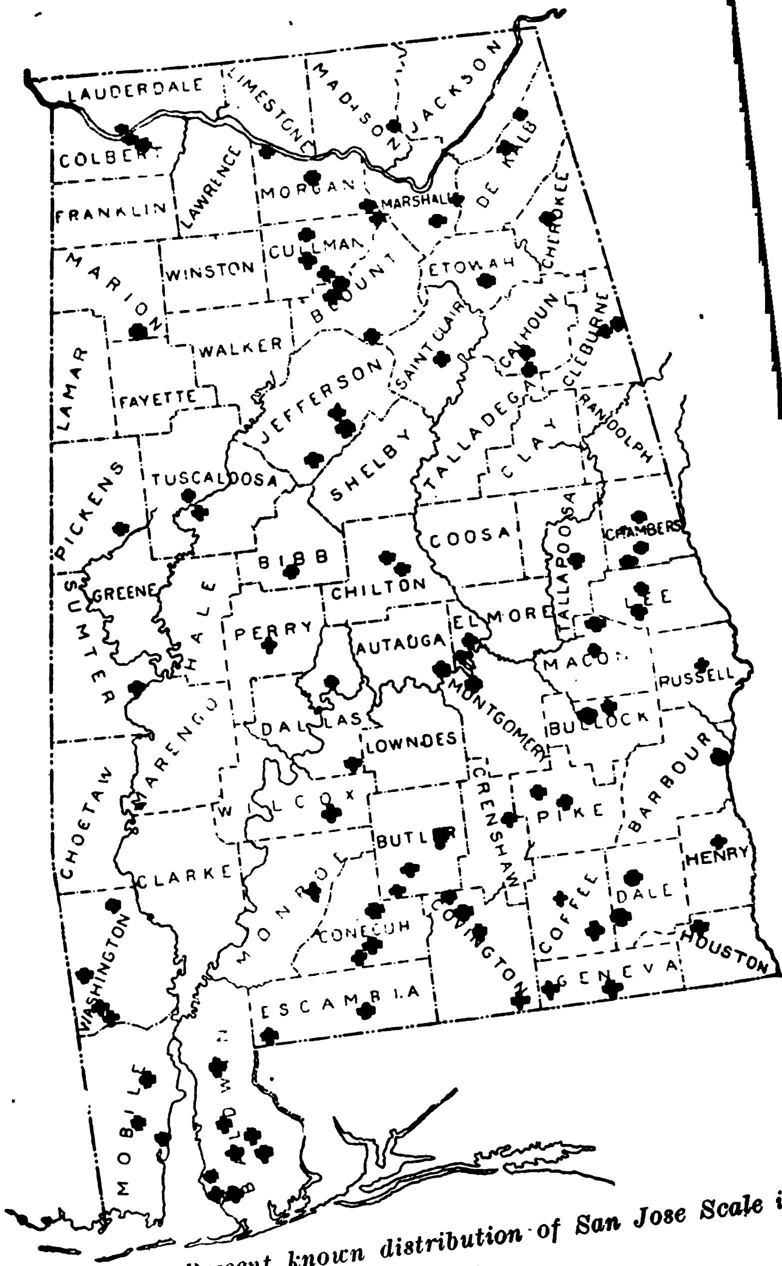


FIG. 1. *Present known distribution of San Jose Scale in Alabama.*

INTRODUCTION AND SPREAD OF THE PEST.—This insect is not a native of the United States but appears to have been brought here from China where it occurs commonly upon native food plants. It was introduced into the San Jose Valley, California, about 1870 and the name of that locality where it was first found has been adopted as the common name of the scale. From California the species was brought on nursery stock into the eastern states shortly before 1893. It has since been spread by nursery stock shipments until it now occurs in nearly every State in the Union. During recent years, however, most of the States have passed strict laws requiring the inspection of nurseries for the occurrence of the scale and the fumigation of stock so as to kill any scales which might possibly exist there before the stock can be legally sold and distributed. The nurserymen have co-operated heartily in this effort to prevent the further spread of the pest so that now the buyer of fruit trees is very effectually protected against the planting of already infested trees. Orchards may be started today much more safely than they could ten years ago.

OCCURRENCE OF THE SCALE IN ALABAMA.—The known extent of its occurrence in this State is indicated upon the accompanying map (Fig. 1.). Without doubt it exists in many other places from which it has not yet been reported. Very frequently its presence in an orchard is not detected until some of the trees begin to die whereupon the cause of their death is sought for. A characteristic type of peach tree dying from this scale is shown in Plate I, fig. 1. The dying of the trees does not usually begin until some two or three years after the actual introduction of the scale and it has thus an opportunity to spread unchecked through the orchard.

WHAT IS THE SCALE.—The San Jose scale is a minute, inconspicuous insect which does not, to the untrained observer, appear to be a living creature. The body of the living insect is concealed beneath the circular, waxen scale which it forms for its protection. The largest scales

are smaller than an ordinary pin-head in diameter and are quite flat (See Pl. I, figs. 2 and 3). The scales are hardly more than 1-25 inch across and many of them are smaller still. Beneath the scale the body of the insect may be found as a small, immovable, yellow body (if still alive) which if crushed seems to be filled with a rather thin, yellow, oily liquid. The young of this species are born alive and their powers of reproduction are so remarkable that a tree bearing but few live scales in the Spring may become quite heavily infested by Fall and will then be liable to severe injury during the following season unless some method of destroying the scales is used during the winter.

Close observation with the naked eye shows that the scales are marked with rings of light and dark gray around a nearly black center. When very abundant they give a general ashy-gray appearance to the entire bark which is noticeable at some distance from the tree.

NATURE OF THE INJURY.—On living infested branches, especially on growth two or more years old, the surface becomes irregularly pitted or has depressions in spots where the scales are most abundant. The injury is of two kinds. Much sap is abstracted by the myriads of sucking insects, but more important than this is the effect which these scales have of causing a thickening of the cell walls which are penetrated by their slender mouth parts. This thickening checks the flow of sap in the branches, and this means the ultimate starvation of the parts of the branch beyond. The San Jose produces a distinctive red stain around the point of attack, either upon infested fruit or just under the scale in the bark. This appears upon lightly scraping off the outer bark.

NECESSITY FOR TREATMENT.—So serious is the injury of which this scale is capable that untreated, infested trees are certain to be killed within a very few years. The LIFE OF THE ORCHARD IS AT STAKE and the plain conclusion is evident that it is far more expensive to allow the trees to be destroyed than it would be to con-

trol the scale which can positively be done so as to continue the life of the orchard and the production of profitable crops. The average annual cost per tree for treatment depends mainly upon its size and ranges, for peach trees, from one-half cent to three cents, averaging between one and two cents. The man who will allow his total investment in trees, land and labor through three or four years to be absolutely destroyed for lack of an additional expense of a cent or two per tree each year, cannot be considered as conducting his work upon anything like business principles.

BEST METHOD OF TREATMENT.—The fight against the San Jose scale has developed several methods of treatment which are of positive value. Three points require consideration in determining which of these methods is best and should therefore be used. 1. Safety. 2. Efficiency. 3. Economy. The method which has been shown to best fulfill these conditions is "A WINTER SPRAYING WITH LIME-SULFUR WASH." In spite of numerous efforts to replace this Lime-Sulfur with some other material more easily prepared or less objectionable to handle in application, the fact remains that this is conceded by the great majority of orchardists, as well as by entomologists, to be the best treatment yet found.

It may be applied with safety at any time while the trees are in a dormant condition. A single thorough spraying with a properly prepared wash insures the control, if not the extermination, of the scale and is safer and more reliable than is any other treatment. The cost of treatment, varying in localities and with number of trees to be treated, need not exceed from one to thirty cents per tree according to their kind and size

SEASON FOR MAKING THE APPLICATION.—The safest and most effective time for treating trees for scale is during the dormant period, that is, between the time the leaves drop in the fall and the time the buds start in the spring. Experimental work has shown that a single treatment with Lime-Sulfur made in November or De-

cember is less effective than is a single treatment made in February or March, and that two treatments, one in the Fall and another just before the buds start, are but slightly more effective than is the later treatment alone. The exact time for spraying after January 1st may be decided by convenience as related to other work and by the continuance of the dormant condition of the buds.

A solution strong enough to kill the scale may be applied to the bark without injury at any time during the summer. It may be applied by painting or swabbing it onto the trunks and largest branches to check the summer development of the scale, but such a solution will destroy all foliage touched by it, and cannot therefore be sprayed on as in winter.

At about one-fifth of the strength recommended, however, it is thought by some that Lime-Sulfur can be sprayed upon even peach foliage which is fairly matured as at fruiting time, and that at that strength it will be a very effective agent in the prevention and control of the brown rot of peaches which is now one of the most serious problems in peach production in Alabama.

PREPARATION ON THE ORCHARD FOR TREATMENT.—This is a matter of considerable importance and the exact measures to be applied to each tree depend largely upon the degree of its infestation.

Slightly infested trees should be pruned before being treated as is best for their fruiting regardless of the presence of the scale. With heavily infested and badly injured trees, the pruning should be much more thorough. Trees which are nearly dead should be cut out and, in a young orchard, replaced if desired by new ones. All dead branches should be removed. Branches still alive but which have made very little growth during the preceding season should be strongly cut back, in some cases leaving them as mere "stubs" a foot or two long from the main trunk. If the cuts are more than three-fourths of an inch in diameter their surfaces should be painted over with White Lead. If there is still life enough in the tree

a new top may be formed out of several of the best and most vigorous shoots thrown out from these "stubs." In many cases it may be possible to control the scale and to thus renew the top of badly injured trees, so as to have them again of good size and bearing more fruit in two or three years than would young trees if put in their places. This is entirely a question of orchard management for the quickest and best production of fruit. It is certain that the scale may be controlled so the age and condition of the tree, etc., must decide the question whether it should be pruned and kept or cut out. It is advisable to burn removed trees and branches to get them out of the way and to prevent further spread of insect pests from them to living trees. The scale is not liable to spread if the trees and prunings are not burned but other injurious insects which may breed in the dead wood may spread from them, particularly to scale injured trees and thus cause the death of trees which might otherwise be saved from the scale.

Adjacent thickets or trees of wild plums or cherry, etc., should be cut and burned. Beside the trees mentioned many others are liable to attack by this scale. The following are some of those occurring commonly: Crab apple, apricot, persimmon, several kinds of walnut and of poplar, osage orange, chestnut, sumac, catalpa, cedar, several of the willows, ash, elm, pecan, orange, lemon, strawberry, gooseberry, currant, etc.

THE LIME-SULFUR TREATMENT.—This wash has been very extensively used in California during the past twenty years. In the eastern United States since about 1900 it has been recognized as the best agent for destroying San Jose scale. Its effectiveness depends upon a chemical combination of the lime and sulfur which is brought about practically only under high temperatures. In a general way, if the chemicals are pure, we may reckon upon using practically equal portions of lime and of sulfur. In practice, however, it has been found better to use a somewhat larger quantity of lime, since commer-

cial rock lime varies somewhat in purity and is cheap. The excess of lime simply forms a whitewash which shows plainly the trees that have been treated. An excess of sulfur would remain undissolved in the solution. While this would do no harm, its presence would do no good and it might be considered as a needless item of waste. Both lime and sulfur are effective for some insects and fungi when used separately, but when combined they act far more efficiently. The principal object in making the wash is to produce economically a safe and thoroughly effective spraying solution.

In planning for making and using this wash a number of practical points require consideration for best results.

ESTIMATION OF QUANTITIES OF CHEMICALS NEEDED.—Naturally this is a difficult matter for the man who has never used anything of the kind. The first consideration is the number and the average size of the trees to be treated. If the scale is known to occur anywhere in an orchard, the only safe thing to do is to spray all trees in it, and the treatment should include at least all of our fruit trees which shed their leaves in the Fall. The amount of spray required will obviously depend directly upon the size of the tree. We may take average three to four-year-old peach trees as our standard and estimate that such trees will require about one-half gallon of spray each for thorough work, and no other kind of work is worth while. Each gallon of spray solution will therefore treat two medium-sized trees, while large trees may require two gallons each. In this way an approximate estimate may be made of the number of gallons of spraying solution to be prepared.

The question of formula must be next considered. As a result of a vast amount of experimental and practical work, it appears that the following formula is safe, efficient and economical:

Rock lime ....20 lbs.
Flowers of Sulfur or Sulfur Flour....15 lbs.
Water to make......................................50 gallons

In ordering our chemicals therefore we reckon upon 20 lbs. of lime and 15 lbs. of sulfur for every 50 gallons of spraying solution which we have estimated to be needed. Emphasis should be laid upon the ultimate economy of using only the best and purest chemicals obtainable, regardless of their slightly greater initial cost.

LIME.—This means always freshly burned rock lime or quick lime. The test of quality is the slaking. Good limes should not contain more than ten per cent of impurities. Poor limes may contain 25 per cent of impurities. It is partly on account of these varying percentages of impurities that more lime than sulfur is used in the formula given. A good lime will slake readily and form an even creamy solution with little sediment or coarse matter which is waste.

Much first-class lime is produced in Alabama, particularly that made in the vicinity of Calera. The addresses of several manufacturers may be found in the Appendix on page 20.

The best grade of lime is shipped and handled in barrels. This is the best form in which to buy it, and the cost should not exceed about $1.00 per barrel or 1c per pound for our spray formula. In nearly every town may be found someone who handles a good grade of lime.

SULFUR.—The sulfur used must be very finely powdered to combine readily and completely with the lime in the making of the wash. Two forms of sulfur to be found on the market are perfectly pure and answer this need equally well. The "Flowers of Sulfur" is the finest form and is largely used, but may cost slightly more than does "Sulfur Flour" or "Flour Sulfur" as it is called. The choice between these two depends upon availability and price. Either should be obtainable at about five cents per pound in lots of fifteen pounds or more. If not obtainable at a satisfactory price through local druggists, sulfur may be secured through the wholesale drug firms listed in the Appendix page 20, and from other firms probably as well. Crystalline Sulfur should not be used under any

circumstances, since it is so coarse that it will not combine completely with the lime even with prolonged boiling. The result is a direct waste of sulfur and a wash solution that is liable to contain too little sulfur to be efficient, thus wasting all the chemicals, the labor of application and possibly, too, the life of the trees through ineffective treatment.

PREPARATION OF THE WASH.—For this work some facility for boiling the solution is essential. Where it is to be made on a small scale, and even in the treatment of several thousand trees where only one barrel pump is to be supplied, the cooking may be done quite conveniently in two large cast iron kettles, one of which may hold about 20 to 25 gallons, while the other should hold 40 gallons. The smaller kettle can be used in heating water while the lime and sulfur are being boiled in the larger one. For treatment of from 5,000 to 10,000 trees it is better to have larger kettles holding 75 to 80 gallons and mounted in a brick frame work or furnace. The cooking should be done when possible near a convenient water supply, but it is better to haul the water than the wash. For more than 10,000 trees it will be far better to cook the wash by steam supplied directly from a portable boiler or some such source. the cooking may then be done in barrels placed side by side and preferably upon an elevated platform. The essential point is that the boiler supply about one horse power for each barrel to be boiled with about 30% surplus power for the pumping and heating of water, etc. Wherever possible the water supply and the cooking barrels should be elevated sufficiently to utilize gravity in the flow of the liquids into the cooking barrels and from them into the spray tanks.

The kettle method of preparation will be described particularly as it may be more commonly employed in this State. Much latitude is permissible in the details of the preparation for the cooking. The essential points are to secure the complete and rapid slaking of the lime and the mixture of the sulfur with the lime solution without the

lumping of the sulfur. To avoid this the sulfur should always be mixed to a thin paste with hot water before being poured into the large boiling kettle. If this be done it makes little difference in the final result whether it be added before, after or during the slaking of the lime. The following method is as good as any and easy to follow:

For each 50-gallon lot of spray solution to be prepared mix 15 lbs. of fine sulfur to a thin paste in hot water in some convenient receptacle. Heat about 12 to 15 gallons of water in the 40-gallon kettle and while it is heating add the sulfur paste taking care to break up any lumps that may exist. Then add, lump by lump, the 20 lbs. of best rock lime. By the time the lime is all slaked the solution should be boiling hot. Add about 10 gallons more of hot water and continue the boiling steadily for about one hour. During this time the mixture must be stirred almost constantly to keep it from burning and to insure the complete solution of the sulfur. When properly prepared there should be no residue of sulfur after this cooking. The wash will appear as a rather thick, reddish brown, or dark orange-colored liquid. It gives off a strong odor of sulfur and is caustic in its action. Impurities in the lime may vary the color of the liquid, as does also the excess amount of lime but a variation in color need not affect its efficiency if the wash has been properly stirred and boiled.

From the boiling kettle the wash goes to the spraying barrel into which it should be strained through a brass strainer having about 20 meshes per inch. See fig. 2. This may be purchased or made at home. The strainer should remove all impurities which might clog the nozzles and delay the work in spraying. Never strain the wash through burlap bagging as the lint from the bagging will soon clog the pump. In the barrel the wash may be finally diluted with cold, but preferably with hot, water to make the required 50 gallons of spraying solution. The amounts of lime and sulfur may be varied,

still keeping the proportion between them, in preparing larger or smaller quantities of the wash as may be needed. In general it is better to spray the wash while it is still

Fig. 2.

warm or quite hot. It works easier in the pump and by the time the spray reaches the tree it is cooled so that there is no danger of its doing injury. It is generally considered as desirable to use the wash upon the day it is prepared but this does not seem to be absolutely necessary. Undiluted wash standing till cold will crystalize but the crystals may be again dissolved by reheating thoroughly and the wash is then probably just as good for use as ever.

Spraying Outfit.—While it is possible to apply the wash by painting or swabbing it onto the trunks and larger branches. the smaller branches and twigs cannot be thoroughly treated in this way and this method of application is so wasteful of time and materials that it will be found more economical as well as efficient to do the work with a "bucket pump" such as may be bought for about $6.00. This may serve fairly for the treatment of from 25 to 50 trees if they are small but for large trees,

or more of them, every orchardist should have a "barrel pump." These may be had in different sizes and full de-

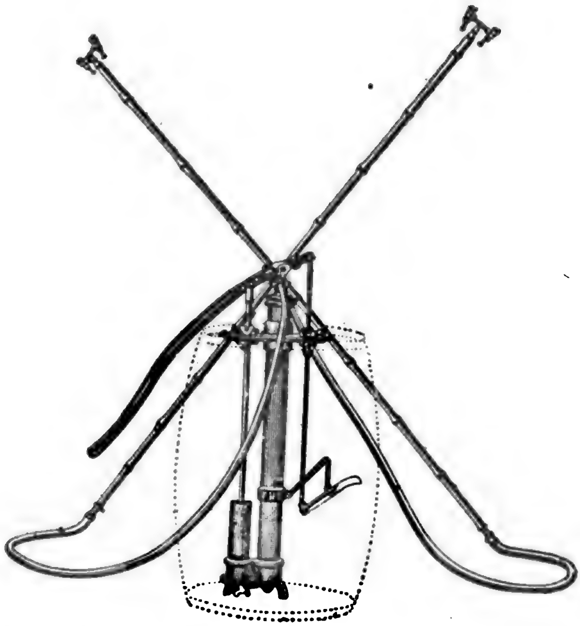


Fig. 3.

scriptions may be found in the catalogs of the various dealers whose addresses are given in the Appendix on page 20–21.

In selecting an outfit for Lime-Sulfur work it is essential that all of the working parts of the pump be of brass and that there be no leather packings or valves. The caustic action of the wash soon corrodes copper and destroys leather but affects brass only slowly. The best apparatus is the cheapest in this case. The most economical outfit for the average orchardist is a barrel pump that is powerful enough to carry two lines of hose with strong pressure for four nozzles. (See fig. 3).

The barrel in which the pump is mounted may well be an ordinary 50-gallon oil barrel such as may be obtained in any town and the mounting of the pump is a simple

operation. The hose should be one-half inch in diameter, inside measure, and of at least four-ply stock. Such hose may be secured of some of the firms mentioned at from 12 to 15 cents per foot. The best hose is not liable to burst under the pressure from the pump and will last much longer than cheaper grades. The length of hose usually furnished by manufacturers with their pumps is too short for satisfactory use. About 25 feet is a good working length for each line as it allows the sprayers more range and insures more rapid and more thorough work which more than offsets the slight extra cost for the longer hose. Each line should be provided with an extension rod from 6 to 12 feet long according to the size of the trees to be treated. There should be two "cut-offs" for each line of hose: one between the pump and the hose and the other between the hose and the extension rod. These save time and liquid and it is more economical to have them than to work without them.

The kind of nozzle to be used is a very important matter. That throwing the best spray is known as the "double Vermorel." There are several types of this nozzle made by various manufacturers which accomplish very similar results. One of these is shown in fig. 4. The

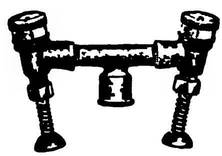


Fig. 4.

nozzle should be provided with plungers to clean them when they become clogged as is liable to happen occasionally even if the wash has been properly strained. The nozzle caps for Lime-Sulfur work should have an opening of 1-16 inch and extra caps should be kept on hand to replace old ones when they become worn so that they throw too coarse a spray. The pressure from the pump should be kept *strong* and especially when four nozzles

are being supplied care must be exercised to see that the pumper does not take his work too easily. The barrel outfit may be carried through the orchard in any kind of a one-horse wagon or on a drag. The driver does the pumping while a man is needed on the ground for each line of hose.

A thoroughly good outfit such as has been described will cost about $25.00 and with proper care it should last for a number of years. It will serve equally well in the application of all arsenical poisons for leaf and fruit feeding insects or for those attacking many of the garden or field crops. It may also be used for whitewashing. Altogether such an outfit is one of the most profitable pieces of equipment that any orchardist can own. Its intelligent use will go farther toward the production of *profits* with almost any crop than can any equal expenditure made in other ways without the spraying.

Information regarding "power sprayers" may be had from the catalogs of manufacturers and suggestions regarding them will be gladly given anyone upon application to the Entomologist, Alabama Experiment Station, Auburn, Ala.

SPRAYING SUGGESTIONS.—While much in regard to spraying can be learned only from experience, there are many suggestions that may be of aid to the beginner.

Only the most careful work is worth doing at all. Care should be taken to cover the twigs and small branches as thoroughly as the larger branches and trunks. If the tree is completely dormant, heavy drenching with the wash will not injure it and it is better to use more spray than is really needed than to use too little to do the work thoroughly. Do not undertake to spray when the prospects are for an immediate storm or severe cold spell since if these should occur before the wash has dried thoroughly on the trees the work will have to be repeated to be effective. Good work cannot be done when a strong wind is blowing. Select fair, calm weather for the work whenever possible or else make a second treatment when it is

calm or when the wind is blowing from the opposite direction to that during the first spraying. The spray solution must be continually agitated during the spraying and a properly constructed pump will accomplish this.

The disagreeable effects of getting the wash on the skin may be reduced by rubbing the hands and face with vaseline before spraying. Rubber coats and gloves are, of course, the best protection for the sprayers but if not available old clothes should be worn so that they may be discarded after the work is finished. Cheap canvas work gloves are a satisfactory protection for the hands. The mules, or horses, and the harness may well be protected by blankets made of old burlap sacks.

After the days work is over the remaining solution should be drawn or emptied out and clear water run through the pump, hose and nozzles to leave them in clean condition and reduce the corrosive injury to the outfit which would otherwise be as great through a night of standing as through a day of use. This cleaning should be particularly thorough at the end of each seasons work or when the apparatus is to be stored for any length of time. All working parts should be kept thoroughly oiled. These measures of care will reduce the expenses for repairs and improve the ease and quality of the work done.

GENERAL USEFULNESS OF LIME-SULFUR WASH.—Its superior power of controlling the San Jose scale is but one of the many advantages of this wash. It adheres to the trees for a long time and its good effects are continued through several months after the application. It acts both as an insecticide and also as a fungicide.

As an insecticide it is effective for nearly all of the scale insects oscurring upon fruit trees. It destroys the winter eggs of the plant lice which attack the leaves and twigs of apple so abundantly in the Spring. It also controls the "pear-tree Psylla" and the "pear-leaf blister mite" as well as the ,'silvering mite" of the peach and the "peach-twig borer."

At the same time as a fungicide it is exceedingly effec-

tive against the "peach-leaf curl" and the "brown rot," also for the "apple scab" and "pear scab" and other fungous diseases of fruits.

These fruit pests cannot all be reached at the same time with any other of the numerous methods of treatment which are sometimes substituted for the Lime-Sulfur for controlling the San Jose scale. No other insectitude now known can equal in range of usefulness and in economy a single thorough application of Lime-Sulfur wash to fruit trees just before the buds start in the Spring.

Manifestly these important considerations in favor of Lime-Sulfur far outweigh all contrary ones based upon the inconvenience in its preparation and the disagreeableness of handling and applying it. To obviate the objections to the preparation of the wash any one who desires may now buy it in a concentrated solution ready to dilute directly with water for spraying. It is sold by several of the manufacturers of insecticides whose addresses are given in the Appendix on page 21–22. This might be particularly desirable for the man who needs but little of the wash. The commercial article has shown up favorably in experimental tests but apparently has no superiority in effect over the home-made article which, of course, costs somewhat less.

DETERMINATION OF SPECIMENS AND SPECIAL ADVICE.—Specimens suspected of being San Jose scale, and any other insects attacking fruits, trees, garden and field crops, etc., may be submitted to the Entomologist, Alabama Experiment Station, Auburn, Ala., for determination. They should be mailed in a tight, strong box bearing plainly on the outside the name and address of the sender and separate from the letter of advice which should describe as fully as possible the nature and extent of the injury which the insect seems to be doing. The Entomologist will gladly and freely give any suggestions possible for combating insect pests thus brought to his attention.

APPENDIX

INSECTICIDE MATERIALS AND SPRAYING APPARATUS: ADDRESSES OF DEALERS AND MANUFACTURERS.

Believing that much of the failure to adopt recommendations for spraying treatment for insect and fungus pests is due to a lack of definite knowledge as to just where reliable materials and equipment may be secured, we give below the addresses of some of the many firms manufacturing or dealing in insecticide materials and apparatus. In doing this we do not mean to imply that other dealers do not make or handle just as reliable and satisfactory goods. Those listed may be depended upon and are as accessible as possible to the people of Alabama.

Lime Works.

Newala Lime Works, Calera, Ala.
Calera Lime Works, Calera, Ala.
Keystone Lime Works, Calera, Ala.
Longview Lime Works, Calera, Ala.

Wholesale Sulfur Dealers.

Durr Drug Co., Montgomery, Ala.
Greil Bros., Montgomery, Ala.
Jacob's Pharmacy, Wholesale Department, Atlanta, Ga.
Mobile Drug Co., Mobile, Ala.

Spraying Machinery.

Morrill and Morley, Benton Harbor, Mich. (Local agency G. W. Barnett Hardware Co., Montgomery, Ala.)

Goulds Mfg. Co., Seneca Falls, N. Y. (Goods handled by Beck & Gregg Hardware Co., Atlanta, Ga.; Alabama Machinery & Supply Co., Montgomery, Ala.)

The Deming Co., Salem, Ohio. (No local agency so far as we know.)

Frost Insecticide Co., Arlington, Mass. (No local agency.)

Dayton Supply Co., Dayton, Ohio. (Agency with Macon Implement Co., Macon, Ga.; Alabama agencies are being established also.)

F. E. Myers & Bro., Ashland, Ohio. (Agencies with Barney-Cavenaugh Hardware Co., Mobile, Ala.; Selma Hardware Co., Selma, Ala.; and Alabama Machinery & Supply Co., Montgomery, Ala.)

Insecticide Manufacturers and Dealers.

Graselli Chemical Co., Birmingham, Ala. (Make and sell Lime-Sulfur solution, Arsenate of Lead, Bordeaux mixture, etc.)

Bowker Insecticide Co., 43 Chatham St., Boston, Mass. (Sell a number of kinds of specially prepared insecticides.)

Frost Insecticide Co., Arlington, Mass.

Rex Co., Omaha, Nebraska. (Sell Lime-Sulfur solution and Arsenate of Lead particularly.)

Thomsen Chemical Co., Baltimore, Md. (Sell Lime-Sulfur solution.)

Fred. L. Lavanburg, 100 William St., New York, N. Y. (For Paris Green and Arsenate of Lead particularly.)

Merrimac Chemical Co., 33 Broad St., Boston, Mass. (Makers of Swift's Arsenate of Lead.)

Adler Color & Chemical Co., New York, N. Y. (Make Paris Green, Arsenate of Lead, etc.)

Acme Color Works, 100 William Sreet, New York, N. Y. (Paris Green, etc.)

A. B. Ansbacher & Co., New York, N. Y. (Paris Green, etc.)

F. W. Devoe & Co., New York, N. Y. (Paris Green, etc.)

Leggett & Brother, New York, N. Y. (Various insecticides.)

Sherwin-Williams Co., Newark, N. J. (Paris Green.)

American Horticultural Distributing Co., Martinsburg, W. Va. ("Target Brand" insecticides.)

B. G. Pratt Co., 11 Broadway, New York, N. Y. (Scalecide.)

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN.

Local Fertilizer Experiments With Cotton in 1895, 1896, 1897 and 1898

BY

J. F. DUGGAR, Director.

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1909

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LOCAL FERTILIZER EXPERIMENTS WITH COTTON IN 1905, 1906, 1907, AND 1908.

By J. F. Duggar.

For a number of years this Station has conducted numerous local fertilizer experiments, furnishing material and instructions to farmers agreeing to make the tests.

The number of local fertilizer experiments with cotton, of which reports were received, was as follows: In 1905, ten; in 1906, thirteen; in 1907, ten; and in 1908, twenty-two. This does not include a number of experiments begun and not successfully completed. In all of these years fertilizer experiments were also made on corn and other crops, the results of which will be published later.

The chief object of these local fertilizer experiments or soil tests has been to ascertain the best fertilizer or combination of fertilizers for cotton, growing on each of the principal soils of Alabama.

Small lots of carefully weighed and mixed fertilizers were supplied to each experimenter. Detailed instructions as to how to conduct the experiments and blank forms for reporting results, were also furnished.

The following list gives the name and address of each experimenter who has reported the results of fertilizer experiments made under our direction during the past four years, with page of this bulletin where the results may be found.

County.	Post Office	Name.	Date.	Page
Autauga	Prattville	J. W. Young	1905-6	49-52
Barbour	Louisville	J. D. Veal	1906	69
Blount	Tidmore	Jno. W. Staab	1905	39-42
Bullock	Union Spr'gs	F. B Haynes	1908	78
Bullock	Three Notch	A. M. Cope	1906	68-69
Bullock	Suspension	O. M. Hill	1906	78
Chambers	Fredonia	E. W. Smartt	1905	78
Chilton	Verbena	G. H. Caffey	1907-8	49-50
Chilton	Verbena	J. H. Willoughby	1905-6-8	47-49
Conecuh	Betts	R. H. Betts	1905-6-7	75-76
Cullman	Cullman	L. A Fealy	1906	39-42
Cullman	Joppa	O. G. Roberts	1906-7-8	39-40
Fayette	Newtonville	J. B. Gibson	1906-7-8	45-47, 78
Franklin	Russellville	T. J. Willis	1905-6	29-30
Geneva	Geneva	M P. Metcalf	1905	69-70
Greene	Eutaw	W. W. Morgan	1908	48
Henry	Headland	W. F. Covington	1907-8	73
Henry	Columbia	T. Z. Atkeson	1908	71-73

County	Post Office	Name	Date	Page
Lauderdale	Florence	W. A. Parish	1905-6	30-31
Lauderdale	Florence	J. W. Haddock	1907-8	30-32
Lawrence	Hillsboro	F. T. Nealy	1905	35
Lee	Auburn	Ala. Expt. Station	1905-6	59
Lee	Auburn	Jno Jackson	1908	57-58
Lee	Bee Hive	T. W. Cox	1905-6	58
Macon	Notasulga	S. C. Jackson	1905	61-64
Macon	Shorter	Y. Swearington	1906	61-65
Macon	Society Hill	Robt. Floyd	1806-7	66
Macon	Hurtsboro	A. B. Floyd	1908	66
Madison	Huntsville	H. D. N. Wales	1905	33-35
Marengo	Faundsdale	W. C. McNight	1905	53-54
Marion	Hamilton	6th Dist. Agr. School	1906	39-42
Morgan	Hartselle	J. O. Burleson	1907-8	35-36
Montgom'ry	Montgomery	J. M. Jones	1906-7	54
Montgom'ry	Montgomery	T. M. Oliver	1907	52-56
Montgom'ry	Naftel	W. C. Naftel	1905	78
Pickens	Gordon	D. W. Davis	1906	78
Tallapoosa	Notasulga	M. E. Parker	1907	59
Tallapoosa	Notasulga	E. B. Jackson	1907	61-63
Tallapoosa	Notasulga	J. W. Parker	1907	61-62
Walker	Cordova	J. L. Alexander	1908	39-44
Winston	Nauvoo	W. M. Omary	1908	39-43

The directions stated that land employed for this test should be level and uniform, not manured in recent years, not in cowpeas the preceding year, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity of standard treatment for all plots (except as to kind of fertilizer used) was emphasized.

Fertilizers were applied in the usual manner—that is, drilled before planting.

The Rainfall.

The following data are taken from the records of the Alabama section of the Weather Bureau, and show the average rainfall for the state:

	Inches Rainfall.				
	1905	1906	1907	1908	
January	5.26	4.66	2.20	4.28	......
February	7.24	2.39	5.04	6.30	......
March	3.70	9.26	2.94	4.77	......
April	3.69	1.03	6.26	5.84	......
May	5.51	4.63	7.94	5.34	.....
June	4.56	3.45	2.85	2.75	.....
July	4.56	8.50	5.00	4.72	.....
August	5.30	3.78	3.50	3.44	.....
September	2.51	8.44	5.50	2.42	....
October	4.39	3.54	1.44	1.76	.....
November	1.78	2.50	6.15	1.52	..
December	6.46	4.19	6.01	5.02	.....
Average	55.38	56.56	54.66	48.16	....
Average yearly normal	.....	......	....	....	51

THE FERTILIZERS USED.

The following prices are used, as representing approximately the average cash price in local markets during the last few years:

	Per Ton.
Acid phosphate (14 per cent. available)	$14.00
Cotton seed meal	25.00
Kainit	15.00

Prices naturally vary in different localities. Any one can substitute the cost of fertilizers in his locality for the price given above.

In each experiment two plots were left unfertilized, these being plots 3 and 8. When these yields differed widely the experiment was classed as inconclusive. The increase on plots 4 to 7 is calculated on the assumption that the graduation in fertility is uniform from plot 3 to plot 8. The following table shows what kinds and amounts of fertilizers were used on certain plots; the number of pounds of nitrogen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos.

PRICE ASSUMED FOR SEED COTTON.

The price assumed is $14.00 per ton for seed, and 10 cents per pound for lint, a price found by averaging prices of 9, 11, 11, and 9 cents per pound respectively, for the crops of 1904, '5, '6, '7, and '8. This is equal to 3.8 cents per pound of seed cotton turning out 33 1/3 per cent. of lint. Deducting 6/10 cents per pound as the average cost of picking and ginning, and we have left 3.2 cents as the net value per pound of the increase of seed cotton due to fertilizers. This latter is the figure used in all financial calculations.

Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.

FERTILILERS			MIXTURE CONTAINS			COST OF FERTILIZERS	
Plot No.	Amount per acre.	KIND	Nitrogen	†Available phosphoric acid	Potash.	Per ton	Per acre
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*		
1	200	Cotton seed meal......	13.58	5.76	3.54	$25.00	$2.50
		In 100 *lbs. c. s. meal.**	**6.79**	**2.88**	**1.77**		
2	240	Acid phosphate........	......	36.12	.....	14.00	1.68
		In 100 *lbs. acid phos.*	......	**15.05**	.....		
4	200	Kainit................	......	......	24.60	15.00	1.50
		In 100 *lbs. kainit.*	......	......	**12.30**		
5	200	Cotton seed meal.....	13.58	41.88	3.54	18.99	4.28
	240	Acid phosphate......					
		In 100 *lbs above mixt.*	**3.09**	**9.52**	**.80**		
6	200	Cotton seed meal.....	13.58	5.76	28.14	19.50	4.00
	200	Kainit...............					
		In 100 *lbs. above mixt.*	**3.39**	**1.44**	**7.03**		
7	240	Acid phosphate......	......	......	.....	14.45	3.18
	200	Kainit...............					
		In 100 *lbs. above mixt*	......	**8.21**	**5.59**		
9	200	Cotton seed meal	13.58	41.88	28.14	17.81	5.68
	240	Acid phosphate......					
	200	Kainit...............					
		In 100 *lbs above mixt.*	**2.12**	**6.54**	**4.39**		
10	200	Cotton seed meal	13.58	41.88	15.84	18.24	5.93
	240	Acid phosphate......					
	100	Kainit...............					
		In 100 *lbs above mixt.*	**2.59**	**7.75**	**2.93**		

*Average of many analysis.

†Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by $1\frac{8}{14}$

FRANKLIN COUNTY, 5 MILES NORTH–WEST OF RUSSELLVILLE.
T. J. WILLIS. 1905–6, (See Table, p. 30.)

Dark gray sandy soil, with light colored clay subsoil.

These tests were made on a hilltop which had been in cultivation about 10 years. The forest growth was hardwoods.

It is evident that this soil responded freely to every fertilizer, whether applied singly, by twos, or all three together.

In both years a complete fertilizer (plots 9 or 10) was the most profitable application, closely followed in yield and profit by a mixture of acid phosphate and cotton seed meal. On plot 9 the complete fertilizer increased the yield by 1000 and by 792 pounds of seed cotton. After deducting the cost of the fertilizer (p 29) this left profits of $26.32 and $19.66 per acre. Phosphate was most effective, cotton seed meal next, and kainit least, but still useful.

	1905 Lbs.	1906 Lbs
Average yield of seed cotton, unfertilized	352	376
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	192	24
To acid phosphate plot	172	120
To kainit plot	204	144
To acid phosphate and kainit plot	167	176
Average increase with cotton seed meal	184	116
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	664	456
To cotton seed meal plot	644	552
To kainit plot	739	600
To cotton seed meal and kainit plot	702	632
Average increase with acid phosphate	687	560
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	94	16
To cotton seed meal plot	106	136
To acid phosphate plot	169	160
To cotton seed meal and acid phosphate plot	164	216
Average increase with kainit	133	132

Experiment at Russellville (Franklin Co.) and near Florence (Lauderdale Co.) 1905-6-7-8

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	T. J. WILLIS Russellville 1905: Yield of seed cotton per acre	T. J. WILLIS Russellville 1905: Increase over unfertilized plot	T. J. WILLIS Russellville 1906: Yield of seed cotton per acre	T. J. WILLIS Russellville 1906: Increase over unfertilized plot	J. W. PARISH Florence 1905: Yield seed cotton per acre	J. W. PARISH Florence 1905: Increase over unfertilized plot	W. A. PARISH Florence 1906: Yield of seed cotton per acre	W. A. PARISH Florence 1906: Increase over unfertilized plot	J. W. HADDOCK Florence 1907: Yield of seed cotton per acre	J. W. HADDOCK Florence 1907: Increase over unfertilized plot	J. W. HADDOCK Florence 1908: Yield of seed cotton per acae	J. W. HADDOCK Florence 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal....	520	192	400	24	608	336	408	232	672	72	910	460
2	240	Acid phosphate.....	992	664	832	456	664	392	368	192	1032	432	650	200
3	....	No fertilizer	327	......	376	......	272	....	176	....	600	....	450	....
4	200	Kainit..............	432	94	392	16	608	308	352	179	1424	848	800	340
5	200 200	Cotton seed meal.. Acid phosphate...	1184	836	952	576	1184	857	608	438	1840	1288	1550	1080
6	200 200	Cotton seed meal.. Kainit...........	656	298	536	160	960	606	320	153	1256	728	1010	530
7	240 200	Acid phosphate... Kainit...........	1200	833	992	616	920	539	456	293	....	....	710	220
8	....	No fertilizer	376	......	376	......	408	....	160	....	480	....	500	....
9	200 240 200	Cotton seed meal.. Acid phosphate... Kainit...........	1376	1000	1168	792	816	408	544	384	1208	728	1100	600
10	200 240 100	Cotton seed meal.. Acid phosphate... Kainit...........	1408	1032	896	520	824	416	528	368	872	392	980	480

Lauderdale County, 10 Miles West of Florence.

W. A. Parish, 1905–6. (See Table, p. 30.)

In 1905 stiff light gray soil with red subsoil; in 1906 darker soil, with red clay subsoil.

Both fields had been cleared for 30 or 40 years. The original forest trees are said to have been post oak, red oak, black oak, and hickory. Every fertilizer considerably increased the yield in both years. In both years the largest increase, 857 pounds and 438 pounds of seed cotton respectively, was afforded by plot 5, fertilized with a mixture of cotton seed meal and phosphate. This represents a net profit of $23.14 and $9.73 per acre. In 1904 a test made by Mr. Parish on gray soil with reddish subsoil showed an average increase attributable to cotton seed meal of 249 pounds of seed cotton per acre; an increase deu to acid phosphate of 584 pounds; and an increase due to kainit of 212 pounds of seed cotton. This indicated a need for the complete fertilizer, while the later tests gave good results without kainit.

It seems that this soil needs chiefly phosphoric acid, but that this should usually be supplemented by nitrogen. The soil on which both Mr. Parish and Mr. Haddock made their experiments was that known locally as "The Barrens," and described in soil survey reports as "Clarksville Silt Loam."

	1904	1905	1906
Average yield of seed cotton per acre, unfertilized	452	340	168
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	284	336	232
To acid phosphate plot	269	465	246
To kainit plot	237	298	—26
To acid phosphate and kainit plot	208	—131	91
Average increase with cotton seed meal	249	242	138

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	696	392	192
To cotton seed meal plot	681	521	206
To kainit plot	494	231	114
To cotton seed meal and kainit plot	465	—198	231
Average increase with acid phosphate	584	236	188

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	334	308	179
To cotton seed meal plot	287	270	--79
To acid phosphate plot	132	147	101
To cotton seed meal and acid phosphate plot	71	—449	—54
Average increase with kainit	212	69	37

LAUDERDALE COUNTY, 10 MILES WEST OF FLORENCE.

J. W. HADDOCK, 1907–8. (See Table, p. 30.)

Gray soil, with red subsoil.

This field had been cleared about 40 years, and was of the same character as soil used in Mr. Parish's experiment. The stand was uniform. The results both years agree with Mr. Parish's experiments in showing that the most effective fertilizer was a mixture of acid phosphate and cotton seed meal, the phosphate being more important. It is curious and inexplicable that kainit when applied alone gave a large increase, but when combined with either or both of the other fertilizers it gave little or no increase. These tests, though presenting some figures that cannot be understood, confirmed the conclusions drawn from Mr. Parish's tests, namely, that acid phosphate is most important, that it should be supplemented by cotton seed meal, and that potash is generally unnecessary.

	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	540	475
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	72	460
To acid phosphate plot	856	880
To kainit plote	—120	190
To acid phosphate and kainit plot		380
Average increase with cotton seed meal	269	478
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	432	200
To cotton seed meal plot	121	620
To kainit plot		—120
To cotton seed meal and kainit plot	0 0	70
Average increase with acid phosphate	576	193
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	848	340
To cotton seed meal plot	656	70
To acid phosphate plot		20
To cotton seed meal and acid phosphate	—560	—600
Average increase with kainit	315	—43

MADISON COUNTY, 5 MILES WEST OF HUNTSVILLE.

H. D. N. WALES, 1905. (See Table, p. 35.)

Red soil, with red subsoil.

This worn red lime soil responded freely only to applications of cotton seed meal. Other tests made in Madison County indicate a general need on such soils for both nitrogen and phospahte. Results from potash have been variable, the majority of the tests showing that little or no potash is needed.

	Lbs.
Average yield of seed cotton per acre, unfertilized	376
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	144
To acid phosphate plot	96
To kainit plot	144
Average increase with cotton seed meal	128
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	88
To cotton seed meal plot	40
To kainit plot	—32
Average increase with acid phosphate	24
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	72
To cotton seed meal plot	72
To acid phosphate plot	—48
Average increase with kainit	24

Experiments in Madison, Lawrence and Morgan Counties.

Plot No.	FERTILIZER		HUNTSVILLE		HILLSBORO		HARTSELLE Red land		HARTSELLE Gray land	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	Lbs		*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	520	144	272	48	798	112	780	210
2	240	Acid phosphate	464	88	264	40	776	120	1140	370
3	....	No fertilizer	376	....	224	....	656	....	570	....
4	200	Kainit	448	72	247	21	744	94	680	126
5	200 240	Cotton seed meal Acid phosphate	560	184	496	265	744	100	1210	672
6	200 200	Cotton seed meal Kainit	592	216	424	190	712	74	980	350
7	240 200	Acid phosphate Kainit	416	40	456	219	632	1	900	394
8	....	No fertilizer	376	....	240	....	624	....	490	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	....	....	744	504	864	240	1070	580
10	200 240 100	Cotton seed meal Acid phosphate Kainit	....	....	616	376	752	128	1010	520

LAWRENCE COUNTY, 1 MILE EAST OF HILLSBORO.

F. T. NEALY, 1905. (See Table above.)

Gray sandy loam soil, with yellow subsoil.

This field had been cleared about 70 years of its growth of hardwoods. It had grown up in weeds during the four years preceding this experiment. Rains were almost continuous throughout the season, making cultivation almost impossible. Under these unfavorable conditions a complete fertilizer was the most effective and profitable.

	Lbs.
Average yield of seed cotton per acre, unfertilized	232
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	48
To acid phosphate plot	225
To kainit plot	161
To acid phosphate and kainit plot	285
Average increase with cotton seed meal	180
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	40
To cotton seed meal plot	217
To kainit plot	198
To cotton seed meal and kainit plot	314
Average increase with acid phosphate	192
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	21
To cotton seed meal plot	142
To acid phosphate plot	179
To cotton seed meal and acid phosphate plot	239
Average increase with kainit	145

MORGAN COUNTY, 4 MILES WEST OF HARTSELLE.

J. O. BURLESON, 1907–8. (See Table, p. 35.)

In 1907, *soil, red, lime table land; Subsoil, red. The original growth was hickory, removed about* 80 *years before.*

The soil was the ordinary lime soil of the Tennessee Valley Region. A complete fertilizer afforded the largest yield. Apparently the greatest need was for nitrogen.

In 1908, *typical sandy mountain land, dark gray soil with red subsoil.*

The original growth was shortleaf pine and hardwoods, and the land had been in cultivation about 10 years. The largest increase was afforded by a mixture of cotton seed meal and acid phosphate. The chemical chiefly needed by this soil was acid phosphate.

	Lbs.	Lbs.
Average yield of seed cotton per arre, unfertilized	640	530
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	112	210
To acid phosphate plot	—20	402
To kainit plot	—20	—20
To acid phosphate and kainit plot	239	230
Average increase with cotton seed meal	78	206
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	120	370
To cotton seed meal plot	—12	462
To kainit plot	—93	268
To cotton seed meal and kainit plot	166	230
Average increase with acid phosphate	45	333
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	94	126
To cotton seed meal plot	—38	140
To acid phosphate plot	—119	21
To cotton seed meal and acid phosphate plot	140	—92
Average increase with kainit	19	50

CULLMAN COUNTY, 2 MILES SOUTH WEST OF JOPPA.

O. G. ROBERTS, 1906–7–8. (See Table, p. 39.)

Gray sandy upland with yellow clay subsoil.

The original growth was short leaf pines and hardwoods, characteristic of the Mountain Plateau Region. This field had been cleared for about 24 years.

In all three years the largest profit was made on plot 5 by using a mixture of cotton seed meal and acid phosphate. In every case there was no advantage in adding kainit to the other two chemicals. This inefficiency of potash in these tests is further borne out by the fact that, of the two complete fertilizers, the one with the smaller amount of potash each year afforded the larger yield. These results also agree with the results of Mr. Burleson's tests on similar gray plateau soil.

	1906. Lbs.	1907. Lbs.	1908. Lbs.
Average yield of seed cotton per acre unfertilized	248	360	312
Increase in seed cotton when cotton seed meal was added:			
To unfertilized plot	200	22	144
To acid phosphate plot	174	218	132
To kainit plot	190	58	166
To acid phosphate and kainit plot	—17	43	164
Average increase with cotton seed meal	137	85	152
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	288	174	292
To cotton seed meal plot	262	370	280
To kainit plot	342	121	112
To cotton seed meal and kainit plot	135	114	110
Average increase with acid phosphate	257	195	199
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	75	182	156
To cotton seed meal plot	65	210	178
To acid phosphate plot	129	129	—24
To cotton seed meal and acid phosphate plot	—62	—46	8
Average increase with kainit	52	119	80

Fertilizer Experiments in Blount, Cullman, Marion, Winston and Walker Counties.

Plot No.	Fertilizer: Amount per acre	Fertilizer: Kind	Joppa 1906: Yield of seed cotton per acre	Joppa 1906: Increase over unfertilized plot	Joppa 1907: Yield of seed cotton per acre	Joppa 1907: Increase over unfertilized plot	Joppa 1908: Yield of seed cotton per acre	Joppa 1908: Increase over unfertilized plot	Tidmore 1905: Yield of seed cotton per acre	Tidmore 1905: Increase over unfertilized plot	Cullman 1906: Yield of seed cotton per acre	Cullman 1906: Increase over unfertilized plot	Hamilton 1906: Yield of seed cotton per acre	Hamilton 1906: Increase over unfertilized plot	Nauvoo 1908: Yield of seed cotton per acre	Nauvoo 1908: Increase over unfertilized plot	Cordova 1908: Yield of seed cotton per acre	Cordova 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal...	416	200	438	22	472	144	[568]	[372]	544	152	288	32	490	90	1460	320
2	240	Acid phosphate....	504	288	590	174	620	292	276	80	588	196	310	64	595	195	1560	420
3	....	No fertilizer........	216	....	416	....	328	....	196	......	392	......	256	......	400	......	1140	......
4	200	Kainit.............	304	75	576	182	476	156	264	70	553	136	312	49	480	81	1270	120
5	200 240	Cotton seed meal. Acid phosphate..	664	462	764	392	736	424	380	188	904	[464]	632	362	790	392	1500	340
6	200 200	Cotton seed meal. Kainit...........	520	265	582	232	626	322	376	186	832	368	456	180	605	208	......	......
7	240 200	Acid phosphate.. Kainit...........	648	417	630	303	564	268	220	33	800	312	544	262	550	154	1630	450
8	....	No fertilizer........	280	....	304	....	288	....	184	......	512	......	288	......	395	......	1190	......
9	200 240 200	Cotton seed meal Acid phosphate.. Kainit...........	680	400	650	3450	720	432	372	188	872	360	592	304	820	425	1560	370
10	200 240 100	Cotton seed meal. Acid phosphate.. Kainit...........	720	440	684	380	726	438	352	168	912	400	528	240	860	465	1800	610

Blount County, 2 Miles North of Tidmore.

John W. Staab, 1905. (See Table, p. 39.)

Mulatto, fine sandy loam, with reddish yellow subsoil.

The rainfall was heavy. Apparently plot 1 was on richer land than the other plots. The chief need was for nitrogen. Phosphate and kainit were of little value.

On the other hand, in a similar experiment made by Mr. Staab the preceding year on apparently the same character of land, the increase in yield of seed cotton per acre averaged for cotton seed meal 215 pounds, for acid phosphate 282 pounds, and for kainit 77 pounds.

	Lbs.
Average yield of seed cotton, unfertilized	190
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	
To acid phosphate plot	108
To kainit plot	116
To acid phosphate and kainit plot	155
Average increase with cotton seed meal	126
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	80
To cotton seed meal plot	
To kainit plot	—37
To cotton seed meal and kainit plot	2
Average increase with acid phosphate	15
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	70
To cotton seed meal plot	
To acid phosphate plot	—47
To cotton seed meal and acid phosphate plot	00
Average increase with kainit	8

Cullman County, 1 Mile South of Cullman.

L. A. Fealy, 1906. (See Table, p. 39.)

Gray sandy loam, with yellow loam subsoil.

On this upland field, long in cultivation, a mixture of acid phosphate and cotton seed meal gave the largest yield; but this result may have been due to the fact that this plot occupied the lowest position in the field. On this account it is impossible to determine whether potash was needed on this soil.

In 1904 on similar land Mr. Fealy made a test in which the average increase from cotton seed meal was 180 pounds, from acid phosphate 176 pounds, and from kainit 98 pounds.

	Lbs.
Average yield of seed cotton, unfertilized	452
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	152
To acid phosphate plot	268
To kainit plot	232
To acid phosphate and kainit plot	48
Average increase with cotton seed meal	175
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	196
To cotton seed meal plot	312
To kainit plot	176
To cotton seed meal and kainit plot	—8
Average increase with acid phosphate	169
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	136
To cotton seed meal plot	216
To acid phosphate jlot	116
To cotton seed meal and acid phosphate plot	—104
Average increase with kainit	91

Marion County, Hamiltoon.

Sixth District Agricultural School, 1906. (Table, p. 39.)

Sandy land with yellow clay subsoil.

For 3 or 4 years preceeding the experiment this land had been uncultivated and occupied by weeds.

The largest and most profitable yield was afforded by plot 5, fertilized with cotton seed meal and acid phosphate. A test made on the same farm in 1903 (Ala. Station Bulletin No. 131) showed a need for a complete fertilizer, in which, however, potash was less effective than either nitrogen or phosphate.

	Lbs.
Average yield of seed cotton per acre, unfertilized	272
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	32
To acid phosphate plot	298
To kainit plot	131
To acid phosphate and kainit plot	42
Average increase with cotton seed meal	126
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	64
To cotton seed meal plot	330
To kainit plot	213
To cotton seed meal and kainit plot	124
Average increase with acid phosphate	183
Increase of seed cotton per acre when kainit was added:	
Averge yield of seed cotton per acre, unfertilized	397
To unfertilized plot	49
To cotton seed meal plot	148
To acid phosphate plot	198
To cotton seed meal and acid phosphate plot	—58
Average increase with kainit	84

WINSTON COUNTY, 3 MILES NORTH EAST OF NAUVOO.

W. M. OMARY, 1908. (See Table, p. 39.)

Gray sandy soil with a reddish clay subsoil; "coal land."

This field had been in cultivation only about 6 years; the original growth is stated to have been short leaf pine.

While a complete fertilizer afforded the largest yield, yet the increase on plot 5, receiving only cotton seed meal and phosphate, was almost as large and the profit on plot 5 was even greater than on plot 9.

	Lbs.
Average yield of seed cotton per acre, unfertilized	397
Increase of seed cotton where cotton seed meal was added:	
To unfertilized plot	90
To acid phosphate plot	197
To kainit plot	127
To acid phosphate and kainit plot	271
Average increase with cotton seed meal	171
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	195
To cotton seed meal plot	302
To kainit plot	73
To cotton seed meal and kainit plot	217
Average increase with acid phosphate	197
Incraese of seed cotton per acre when kainit was added:	
To unfertilized plot	81
To cotton seed meal plot	118
To acid phosphate plot	—41
To cotton seed meal and acid phosphate plot	33
Average increase with kainit	48

Walker County, 3 Miles South of Cordova.

G. L. Alexander, 1908. (See Table, p. 39.)

Gray sandy upland with red clay subsoil.

This field had been cleared for about 40 years. Evidently the land had been kept in a high state of fertility.

The stand was uniform.

It is clear that the chief need of this soil was for acid phosphate. There was no need for potash. The figures for nitrogen are confusing, probably due to the relatively productive condition of this land. Apparently plot 10 was on richer soil than the other plots.

Average yield of seed cotton per acre, unfertilized	1165
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	320
To acid phosphate plot	—80
To acid phosphate and kainit plot	—80
Average increase with cotton seed meal	54
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	420
To cotton seed meal plot	20
To kainit plot	330
Average increase with acid phosphate	257
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	120
To acid phosphate plot	30
To cotton seed meal and acid phosphate plot	30
Average increase with kainit	60

FAYETTE COUNTY, 1 1–2 MILES WEST OF NEWTONVILLE.

J. B. GIBSON, 1906–7. (See Table, p. 46.)

Dark sandy soil with red clay subsoil.

This level upland field, on which the original growth was oak and short leaf pine, has been cleared about 18 years.

There was an increase with either cotton seed meal, acid phosphate, or kainit, whether these were used separately or in every possible combination. Apparently the greatest need was for acid phosphate.

	1906. Lbs.	1907. Lbs.
Average yield of seed cotton, unfertilized	560	348
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	784	576
To acid phosphate plot	24	86
To kainit plot	72	54
To acid phosphate and kainit plot	216	92
Average increase with cotton seed meal	274	202
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	880	640
To cotton seed meal plot	120	150
To kainit plot	128	129
To cotton seed meal and kainit plot	268	167
Average increase with acid phosphate	349	272
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	720	611
To cotton seed meal plot	8	89
To acid phosphate plot	—32	100
To cotton seed meal and acid phosphate plot	160	106
Average increase with kainit	214	227

Fertilizer Experiments in Fayette and Greene Counties.

Plot No	Fertilizer: Amount per acre	Fertilizer: Kind	Newton-ville 1906: Yield of seed cotton per acre	Newton-ville 1906: Increase over unfertilized plot	Newton-ville 1907: Yield of seed cotton per acre	Newton-ville 1907: Increase over unfertilized plot	Clint'n 1908: Yield of seed cotton per acre	Clint'n 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	1304	784	912	576	768	144
2	240	Acid phosphate	1400	880	976	640	760	136
3	....	No fertilizer	520	......	336	......	624	....
4	200	Kainit	1256	720	952	611	672	49
5	200 240	Cotton seed meal Acid phosphate	1456	904	1072	726	696	74
6	200 200	Cotton seed meal Kainit	1360	792	1016	665	687	08
7	240 200	Acid phosphate Kainit	1432	848	1096	740	622	14
8	....	No fertilizer	600	......	360	......	616	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1664	1064	1192	832	680	64
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1600	1000	1272	912	704	88

Greene County, 6 Miles North of Clinton.

W. M. Morgan, 1908. (See Table above.)

Dark soil with clay foundation.

The original growth, consisting chiefly of short leaf pine, was removed about nine years before the test was made. The two crops preceding the experiment consisted of cotton. No fertilizer very greatly increased the yield. From Mr. Morgan's notes it may be inferred that the land is in poor mechanical condition, much inclined to bake, and that on all plots there was much shedding of forms, but no rust.

	Lbs.
Average yield of seed cotton per acre, unfertilized	620
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	144
To acid phosphate plot	—62
To kainit plot	19
To acid phosphate and kainit plot	50
Average increase with cotton seed meal	38
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	136
To cotton seed meal plot	—70
To kainit plot	—35
To cotton seed meal and kainit plot	—4
Average increase with acid phosphate	7
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	49
To cotton seed meal plot	—76
To acid phosphate plot	—122
To cotton seed meal and acid phosphate plot	—10
Average increase with kainit	—40

CHILTON COUNTY, 2 MILES WEST OF VERBENA.

J. H. WILLOUGHBY, 1905–6–7–8. (See Table, p. 49.)

Gray sandy soil with a red subsoil.

Every year this test was made on soil that had been long in cultivation. In each of the four years the complete fertilizer (plot 9) afforded a larger yield than the mixture of any two fertilizers. In every test the complete fertilizer afforded the largest net profit. When the chemicals were used separately or by twos their effect was variable, but when all 3 were combined each chemical in this mixture increased the yield more than enough to pay its cost.

	1905 Lbs.	1906 Lbs.	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre unfertilized	408	256	328	550
Increase of seed cotton when cotton seed meal was added:				
To unfertilized plot	384	104	64	230
To acid phosphate plot	104	85	60	142
To kainit plot	96	21	—36	—18
To acid phosphate and kainit plot	272	62	279	256
Average increase with cotton seed meal	214	68	60	153
Increase of seed cotton per acre when acid phosphate was added:				
To unfertilized plot	168	128	32	50
To cotton seed meal plot	—112	109	156	—38
To kainit plot	16	36	—101	—142
To cotton seed meal and kainit plot	192	77	214	132
Average increase with acid phosphate	66	87	75	1
Increase of seed cotton per acre when kainit was added:				
To unfertilized plot	136	206	158	186
To cotton seed meal plot	—152	123	186	—62
To acid phosphate plot	—16	114	25	—6
To cotton seed meal and acid phosphate plot	152	91	244	108
Average increase with kainit	30	133	153	57

Verbena (Chilton County) Experiments by J. H. Willoughby and G. H. Caffey.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	VERBENA W. 1905: Yield of seed cotton per acre	VERBENA W. 1905: Increase over unfertilized plot	VERBENA W. 1906: Yield of seed cotton per acre	VERBENA W. 1906: Increase over unfertilized plot	VERBENA W. 1907: Yield of seed cotton per acre	VERBENA W. 1907: Increase over unfertilized plot	VERBENA W. 1908: Yield of seed cotton per acre	VERBENA W. 1908: Increase over unfertilized plot	VERBENA C. 1907: Yield of seed cotton per acre	VERBENA C. 1907: Increase over unfertilized plot	VERBENA C. 1908: Yield of seed cotton per acre	VERBENA C. 1908: Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	752	384	376	104	640	64	820	230	888	144	7[illegible]0	160
2	240	Acid phosphate	536	168	4[illegible]0	128	736	32	640	50	653	91	710	80
3	....	No fertilizer	368	......	272	......	704	......	590	......	744	......	630	......
4	200	Kainit	520	136	472	206	832	158	760	186	904	196	650	40
5	200 240	Cotton seed meal Acid phosphate	672	272	472	213	736	92	750	192	848	177	910	320
6	200 200	Cotton seed meal Kainit	648	232	380	227	736	122	710	168	848	214	740	170
7	240 200	Acid phosphate Kainit	584	152	488	242	640	57	570	44	700	103	680	130
8	....	No fertilizer	448	......	240	......	552	......	5[illegible]0	......	560	......	530	......
9	200 240 200	Cotton seed meal Acid phosphate Kainit	872	424	544	304	888	336	810	300	1024	464	860	303
10	200 240 100	Cotton seed meal Acid phosphate Kainit	760	312	456	216	856	304	800	290	952	392	810	280

Chilton County, 1–2 Mile South of Verbena.
G. H. Caffey, 1907–8. (See Table, p. 49.)

Rather stiff, dark, sandy soil, with a red clay subsoil.

This piece of high upland was cleared 60 or 70 years ago of its original growth of longleaf pine, oak, hickory, and dogwood. The results for the two years suggest that the fertilizer which pays best one season is not necessarily the one most effective in a different season. In 1907 there was need for a complete fertilizer, in which the most effective constituent was nitrogen, closely followed by potash; phosphate was also helpful when used in combination, with *both* of the other constituents.

In 1908, on the contrary, kainit was of practically no value nitrogen being most important, followed by phosphate. A mixture of cotton seed meal and phosphate gave the greatest profit.

In 1907 the complete fertilizer on plot 9, costing $5.68 per acre, increased the yield of seed cotton by 464 pounds per acre, worth at 3.2 cents, $14.85. This leaves a net profit of $8.17 due to the complete fertilizer. Likewise in 1908 the increase on plot 5, with meal and phosphate costing $4.28, afforded a net profit of $5.96.

	1907 Lbs.	1908 Lbs.
Average yield of seed cotton unfertilized	652	580
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	144	160
To acid phosphate plot	268	240
To kainit plot	18	130
To acid phosphate and kainit plot	361	200
Average increase with cotton seed meal	198	183

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	—91	80
To cotton seed meal plot	33	160
To kainit plot	—93	90
To cotton seed meal and kainit plot	250	160
Average increase with acid phosphate	25	123

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	196	40
To cotton seed meal plot	70	10
To acid phosphate plot	194	50
To cotton seed meal and acid phosphate plot	287	10
Average increase with kainit	187	28

AUTAUGA COUNTY, 2 MILES EAST OF PRATTVILLE.
J. W. YOUNG, 1905–6–7. (See Table, p. 52.)

Reddish sandy soil with a red clay subsoil.

The stand each year was good and uniform. Results were somewhat obscured by unfavorable weather conditions in 1905 and by the September storm and the occurrence of early frost in 1906. Evidently the chief need of the soil, long in cultivation, was for nitrogen. Phosphoric acid was also needed. A mixture of cotton seed meal and acid phosphate, (plot 5), in all cases gave a profitable increase. In a complete fertilizer in 1905 and 1906 kainit increased the yield to the extent of 112 and 77 pounds of seed cotton respectively; but when used alone or in combination with either one of the other fertilizers, kainit was usually unprofitable, and it was also without effect in the complete fertilizer in 1907.

Autauga and Montgomery (Sandy Land) Experiments.

Plot No.	Amount per acre	FERTILIZER KIND	Prattville 1904 Yield of seed cotton per acre	Prattville 1904 Increase over unfertilized plot	Prattville 1905 Yield of seed cotton per acre	Prattville 1905 Increase over unfertilized plot	Prattville 1906 Yield of seed cotton per acre	Prattville 1906 Increase over unfertilized plot	Montgomery Red sandy Yield of seed cotton per acre	Montgomery Red sandy Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	816	184	936	296	912	156	744	112
2	240	Acid phosphate	752	120	800	160	816	60	664	32
3	....	No fertilizer	632	....	640	....	756	.....	632	....
4	200	Kainit	640	24	680	34	780	12	552	66
5	200 240	Cotton seed meal Acid phosphate	760	160	840	187	888	109	720	116
6	200 200	Cotton seed meal Kainit	752	168	760	101	892	102	752	1620
7	240 200	Acid phosphate Kainit	744	176	696	30	708	93	643	73
8	....	No fertilizer	552	....	672	....	812	.....	560	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	824	272	936	264	880	68	824	264
10	200 240 100	Cotton seed meal Acid phosphate Kainit	768	216	856	184	800	12	840	280

	1905	1906	1907
	Lbs.	Lbs.	Lbs.
Average yield of seed cotton, unfertilized	592	656	784
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	184	296	156
To acid phosphate plot	40	27	49
To kainit plot	144	67	90
To acid phosphate and kainit plot	96	234	151
Average increase with cotton seed meal	116	156	112
Increase of seed cotton per acre when acid phospahte was added:			
To unfertilized plot	120	160	60
To cotton seed meal plot	—24	—109	—47
To kainit plot	152	—4	—105
To cotton seed meal and kainit plot	104	163	—34
Average increase with acid phosphate	88	53	—32

Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	24	34	12
To cotton seed meal plot	—16	—195	—54
To acid phosphate plot	56	—130	—153
To cotton seed meal and acid phosphate plot	112	77	—41
Average increase with kainit	44	—53	—59

MARENGO COUNTY, 2 MILES SOUTH OF FAUNSDALE.

W. C. MCKNIGHT, 1905. (See Table, p. 54.)

Yellowish, gravelly, prairie upland.

The largest increase and the only plot showing any decided profit from fertilizers was plot 10, which received 550 pounds of a complete fertilizer.

	Lbs.
Average yield of seed cotton per acre, unfertilized	414
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	62
To acid phosphate plot	170
To kainit plot	48
To acid phosphate and kainit plot	210
Average increase with cotton seed meal	122
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	—82
To cotton seed meal plot	56
To kainit plot	—42
To cotton seed meal and kainit plot	120
Average increase with acid phosphate	13
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	—20
To cotton seed meal plot	56
To acid phosphate plot	20
To cotton seed meal and acid phosphate plot	30
Average increase with kainit	21

Fertilizer Experiments in Marengo and Montgomery Counties on prairie or lime soils.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	FAUNSDALE: Yield of seed cotton per acre	FAUNSDALE: Increase over unfertilized plot	MONTGOM'RY Prairie: Yield of seed cotton per acre	MONTGOM'RY Prairie: Increase over unfertilized plot	MONTGOM'RY Prairie: Yield of seed cotton per acre	MONTGOM'RY Prairie: Increase over unfertilized plot	MONTGOM'RY Prairie: Yield of seed cotton per acre	MONTGOM'RY Prairie: Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal.....	516	62	492	120	256	78	643	143
2	240	Acid phosphate......	372	82	648	276	320	14	483	15
3	....	No fertilizer	454	....	372	....	334	....	498	....
4	200	Kainit	418	20	558	183	580	233	590	119
5	200 240	Cotton seed meal... Acid phosphate....	540	118	528	149	402	42	578	134
6	200 200	Cotton seed meal .. Kainit	434	28	528	146	694	322	663	246
7	240 200	Acid phosphate.... Kainit.............	328	62	648	268	690	306	593	203
8	....	No fertilizer	374	....	388	....	396	....	363	....
9	200 240 200	Cotton seed meal... Acid phosphate.... Kainit.............	522	148	694	310	672	276	853	490
10	200 240 100	Cotton seed meal .. Acid phosphate.... Kainit.............	638	264	726	338	618	220	723	360

MONTGOMERY COUNTY, 6 MILES SOUTH EAST OF MONTGOMERY.
WESLEY N. JONES AND SONS, 1906-7-8.

Black prairie soil in 1906; *reddish prairie soil in* 1907; *chocolate or "mulatto" prairie soil in* 1908.

In 1906 on black or dark gray prairie upland soil, the greatest increase, 338 pounds of seed cotton per acre, and the largest profit, was afforded by the complete fertilizer applied to plot 10. Apparently the chief need that year was for acid phosphate, though kainit was also helpful.

In 1907 the greatest increase was afforded by a mixture of cotton seed meal and kainit, closely followed by the plot receiving acid phosphate and kainit. In this test kainit was the only profitable fertilizer and was effective whether used alone or in combination with either acid phosphate or

kainit. The poor results on plots 1 and 2 and 5 appear to be partly due to the slightly poorer stand on those plots.

In 1908 a complete fertilizer was the most profitable; in this potash was most important, nitrogen next. Acid phosphate was ineffective when used alone or with meal, but profitable when combined with both kainit and meal, making a complete fertilizer.

In the 3 tests on this typical prairie soil, the most profitable fertilizer was in two cases a complete fertilizer and in one case kainit.

	1906 Lbs	1907 Lbs	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	380	365	431
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	120	—78	145
To acid phosphate plot	—127	66	149
To kainit plot	—37	89	127
To acid phosphate and kainit plot	42	—30	187
Average increase with cotton seed meal	—1	12	152
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	276	—14	—15
To cotton seed meal plot	29	120	—11
To kainit plot	85	73	84
To cotton seed meal and kainit plot	164	—46	144
Average increase with acid phosphate	130	33	50
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	183	233	119
To cotton seed meal plot	26	400	101
To acid phosphate plot	—8	320	218
To cotton seed meal and acid phosphate plot	161	234	356
Average increase with kainit	91	297	199

MONTGOMERY COUNTY, 7 MILES EAST OF MONTGOMERY.
THOS. W. OLIVER, 1907. (See Table, p. 52.)

Red sandy soil 4 to 6 in deep; red clay subsoil.

The field had been cleared perhaps 70 years before. The original growth was reported as short leaf pine and oak.

The season was unfavorable, the spring being very wet and the late summer very dry and hot.

A complete fertilizer, especially the one on plot 10, was the most profitable.

	Lbs.
Average yield of seed cotton per acre, unfertilized	596
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	112
To acid phosphate plot	84
To kainit plot	228
To acid phosphate and kainit plot	191
Average increase with cotton seed meal	154
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	32
To cotton seed meal plot	4
To kainit plot	139
To cotton seed meal and kainit plot	102
Average increase with acid phosphate	69
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	—66
To cotton seed meal plot	50
To acid phosphate plot	41
To cotton seed meal and acid phosphate plot	148
Average increase with kainit	43

Lee County, Experiment Station Farm.

Results of fertilizer experiments in 1905 and 1906 are reserved for another publication. Expressed briefly the results showed that on gray sandy soil (Norfolk sandy loam), the greatest increase was from potash, next from nitrogen, and the least from phosphate. The latter fact may be due to an accumulation of phosphoric acid brought about by fertilization with acid phosphate each year.

Lee County, 2 Miles West of Auburn.

John Jackson, 1908. (See Table, p. 58.)

Gray sandy loam, long in cultivation.

The largest increase, 500 pounds per acre, was afforded by plot 9, on which was used 640 pounds per acre of a complete fertilizer. This represents, at 3.2 cents per pound of seed cotton, a net profit of $10.32 per acre above the cost of fertilizer. It should be added that the increased crop as measured by the scales was very much greater than the appearance of the plants would suggest to the eye.

Every one of the three constituents of the complete fertilizer was profitable in this mixture.

Average yield of seed cotton, unfertilized	560
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	190
To acid phosphate plot	10
To kainit plot	—140
To acid phosphate and kainit plot	320
Average increase with cotton seed meal	95
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	100
To cotton seed meal plot	—80
To kainit plot	—118
To cotton seed meal and kainit plot	350
Average increase with acid phosphate	63

Increase of seed cotton per acre when kainit was added:
To unfertilized plot 290
To cotton seed meal plot ....—40
To acid phosphate plot 80
To cotton seed meal and acid phosphate plot 390

Average increase with kainit 180

Fertilizer Experiments in Lee County.

Plot No.	FERTLIZER: Amount per acre	FERTLIZER: KIND	AUBURN J. Jackson: Yield of seed cotton per acre	AUBURN J. Jackson: Increase over unfertilized plot	BEEHIVE: Yield of seed cotton per acre	BEEHIVE: Increase over unfertilized plot	BEEHIVE: Yield of seed cotton per acre	BEEHIVE: Increase over unfertilized plot
	Lbs.		*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	800	190	428	156	280	96
2	240	Acid phosphate	710	100	424	152	304	120
3	....	No fertilizer	610	....	272	....	184	....
4	200	Kainit	980	290	484	202	304	123
5	200 240	Cotton seed meal ... Acid phosphate	680	110	552	260	560	382
6	200 200	Cotton seed meal ... Kainit	700	150	692	392	400	525
7	240 200	Acid phosphate .... Kainit	710	180	608	297	444	273
8	....	No fertilizer	510	....	320	....	168	....
9	200 240 200	Cotton seed meal ... Acid phosphate .... Kainit	1010	500	624	304	640	472
10	200 240 100	Cotton seed meal ... Acid phosphate .... Kainit	750	240	560	240	560	392

LEE COUNTY, 4 MILES SOUTH OF LOACHAPOKA, AT BEEHIVE.

T. W. Cox, 1905–6.

Coarse sandy soil with yellow sandy subsoil.

This piece of upland had been in cultivation for many years. In 1905 rust was severe on all plots. The stand of plants was uniform. On this very poor coarse sandy soil

plot 6, fertilized with meal and kainit, gave the largest yield and the most profit in 1905, in which year every fertilizer was useful when applied alone or by twos.

In 1906 plot 9, receiving 640 pounds of complete fertilizer, afforded the largest yield and the greatest net profit. The latter test agrees with Mr. Jackson's in showing the need of a complete fertilizer on the coarse gray sandy soils of this region.

	1905 Lbs.	1906 Lbs.
Average yield of seed cotton per acre, unfertilized	296	176
To unfertilized plot	156	96
To acid phosphate plot	108	260
To kainit plot	190	2
To acid phosphate and kainit plot	7	201
Average increase with cotton seed meal	115	140

Increase of seed cotton per acre when acid phosphate was added:

	1905	1906
To unfertilized plot	152	120
To cotton seed meal plot	104	287
To kainit plot	95	150
To cotton seed meal and kainit plot	—88	247
Average increase with acid phosphate	66	201

Increase of seed cotton per acre when kainit was added:

	1905	1906
To unfertilized plot	202	123
To cotton seed meal plot	236	129
To acid phosphate plot	145	153
To cotton seed meal and acid phosphate plot	44	90
Average increase with kainit	157	124

TALLAPOOSA COUNTY, 8 MILES WEST OF NOTASULGA.

M. E. PARKER, 1905–6. (See Table, p. 61.)

Gray sandy upland; yellowish subsoil.

This field was on representative long–leaf pine land, and had been in cultivation about 20 years. The five crops pre–

ceding that of 1905 were cotton fertilized with 200 pounds of guano per acre.

In 1905 cotton rust was severe and a complete fertilizer was most profitable, (plot 9 and 10); this year every fertilizer, whether applied alone, by twos, or all three together greatly increased the yield.

In 1906 the test was conducted on land that had been in oats the year before. This was a rainy season on this farm. Plot 10, with a complete fertilizer gave the largest increase and greatest profit, while plot 9, receiving a complete fertilizer with double this amount of potash, dropped lower in yield. There is no question of the effectiveness of phosphate and meal. But the results with kainit are here contradictory, this fertilizer making a satisfactory increase when used alone and also when used in the complete fertilizer on plot 10; but in other combinations kainit failed to increase the yield to any notable extent.

	1905 Lbs.	1906 Lbs.
Average yield of seed cotton per acre, unfertilized	500	621
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	320	127
To acid phosphate plot	128	104
To kainit plot	40	—26
To acid phosphate and kainit plot	160	88
Average increase with cotton seed meal	162	73
Increase of seed cotton per acre when acid phosphate was added.		
To unfertilized plot	264	183
To cotton seed meal plot	72	166
To kainit plot	16	—35
To cotton seed meal and kainit plot	136	79
Average increase with acid phosphate	122	100
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	336	224
To cotton seed meal plot	56	71
To acid phosphate plot	88	0
To cotton seed meal and acid phosphate plot	120	—16
Average increase with kainit	150	70

Fertilizer Experiments in Tallapoosa and Macon Counties.

Plot No.	Fertilizer: Amount per acre	Fertilizer: Kind	W. Nota'ga M. E. Parker 1905: Yield of seed cotton per acre	W. Nota'ga M. E. Parker 1905: Increase over unfertilized plot	W. Nota'ga M. E. Parker 1906: Yield of seed cotton per acre	W. Nota'ga M. E. Parker 1906: Increase over unfertilized plot	W. Nota'ga J. W. Parker 1907: Yield of seed cotton per acre	W. Nota'ga J. W. Parker 1907: Increase over unfertilized plot	W. Nota'ga E. B. Jackson 1907: Yield of seed cotton per acre	W. Nota'ga E. B. Jackson 1907: Increase over unfertilized plot	W. Nota'ga E. B. Jackson 1908: Yield of seed cotton per acre	W. Nota'ga E. B. Jackson 1908: Increase over unfertilized plot	W. Nota'ga S. C. Jackson 1905: Yield of seed cotton per acre	W. Nota'ga S. C. Jackson 1905: Increase over unfertilized plot	Shorter Swearington 1906: Yield of seed cotton per acre	Shorter Swearington 1906: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal....	840	320	748	127	520	104	272	80	680	280	368	72	256	40
2	240	Acid phosphate.....	784	264	810	189	480	64	256	64	500	100	384	88	264	48
3	....	No fertilizer	520	......	621	......	416	......	192	......	400	......	296	......	216	......
4	200	Kainit	848	336	845	224	512	123	216	25	530	112	368	75	544	325
5	200 240	Cotton seed meal.. Acid phosphate...	896	392	914	293	632	270	296	106	500	84	552	262	464	244
6	200 200	Cotton seed meal.. Kainit...........	872	376	819	198	584	249	312	124	650	236	520	233	768	546
7	240 200	Acid phosphate... Kainit...........	840	352	810	189	568	260	304	118	550	138	344	60	640	416
8	....	No fertilizer	480	......	......	......	280	......	184	......	410	......	280	......	224	......
9	200 240 200	Cotton seed meal.. Acid phosphate... Kainit...........	992	512	898	277	656	376	400	216	680	270	536	256	768	544
10	200 240 100	Cotton seed meal.. Acid phosphate... Kainit...........	1000	520	1026	405	576	296	416	232	720	310	536	256	768	544

TALLAPOOSA COUNTY, 8 1–2 MILES WEST OF NOTASULGA.
J. W. PARKER, 1907. (See Table, p. 61.)

Gray sandy land; yellowish subsoil.

This typical piece of long-leaf pine upland had been cultivated for many years.

The complete fertilizer on plot 10 was the most profitable, affording a net profit of $6.35 per acre, (376 lbs. at 3.2 cents. less $5.68).

June and July were very dry. Rust and shedding were severe on plots 5, 9 and 10; plots 4 and 7 retained their foliage remarkably well.

	Lbs.
Average yield of seed cotton per acre, unfertilized	348
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	104
To acid phosphate plot	206
To kainit plot	126
To acid phosphate and kainit plot	116
Average increase with cotton seed meal	138
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	64
To cotton seed meal plot	166
To kainit plot	137
To cotton seed meal and kainit plot	127
Average increase with acid phosphate	124
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	123
To cotton seed meal plot	145
To acid phosphate plot	196
To cotton seed meal and acid phosphate plot	106
Average increase with kainit	143

TALLAPOOSA COUNTY, 6 MILES WEST OF NOTASULGA.
E. B. JACKSON, 1907–8. (See Table, p. 61.)

Gray sandy upland; yellowish subsoil.

This experiment was made on typical long-leaf pine land, which had been in cultivation for many years. The stands of cotton were good and uniform. There are no records to the presence or absence of cotton rust.

In both years a complete fertilizer was most effective and most profitable. However in a complete fertilizer, 100 pounds of kainit per acre (plot 10) was more advantageous than double this amount, (plot 9.)

	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	188	405
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	80	280
To acid phosphate plot	42	—16
To kainit plot	99	124
To acid phosphate and kainit plot	98	132
Average increase with cotton seed meal	80	130
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	64	100
To cotton seed meal plot	26	—196
To kainit plot	93	26
To cotton seed meal and kainit plot	92	34
Average increase with acid phosphate	69	—9
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	25	112
To cotton seed meal plot	44	—44
To acid phosphate plot	54	·38
To cotton seed meal and acid phosphate plot	110	186
Average increase with kainit	58	73

MACON COUNTY, 6 MILES WEST OF NOTASULGA.
S. C. JACKSON, 1905. (See Table, p. 61.)

Gray sandy pine woods soil with yellowish subsoil.

The original growth was long-leaf pine. The field had been in cultivation for many years. A mixture of acid phosphate and cotton seed meal (plot 5) was sufficient to give the largest yield and greatest profits.

Mr. Jackson noted that on plots receiving the complete fertilizer there were some spots where the plants died, probably from cotton wilt. This may explain why the complete fertilizer did not give a better yield.

	Lbs.
Average yield of seed cotton per acre, unfertilized	288
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	72
To acid phosphate plot	174
To kainit plot	158
To acid phosphate and kainit plot	204
Average increase with cotton seed meal	152
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	88
To cotton seed meal plot	190
To kainit plot	—15
To cotton seed meal and kainit plot	31
Average increase with acid phosphate	73
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	75
To cotton seed meal plot	161
To acid phosphate plot	—28
To cotton seed meal and acid phosphate plot	2
Average increase with kainit	52

MACON COUNTY, 9 MILES WEST OF TUSKEGEE.
YANCEY SWEARINGTON, 1906. (See Table, p. 61.)

Gray sandy soil with yellow loam subsoil.

This field was cleared of its growth of long leaf pine about 60 years ago. The stand was good on all plots. It is notable that the complete fertilizer on plot 6 nearly quadrupled the yield on the unfertilized plots. This complete fertilizer afforded the largest yield and the greatest profit. but was closely followed in yield and profit by plot 6, receiving a mixture of cotton seed meal and kainit. In this test kainit was the most useful single fertilizer, a fact which was probably due to its effect in restraining rust, as indicated by Mr. Swearington's careful observations. By July 10 plot 5 was ruined by rust. Plots 4 and 6 suffered least from rust and were the last to show it. The rust was considered worse on plots 9 and 10 than on plot 5. Apparently rust was worse and earlier on plots receiving phosphate.

Mr. Swearington draws the following conclusion from this test:

"Our lands need more liberal use of potash."

	Lbs.
Average yield of seed cotton per acre, unfertilized	220
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	40
To acid phosphate plot	196
To kainit plot	221
To acid phosphate and kainit plot	184
Average increase with cotton seed meal	160
Increase of seed cotton per acre when acid phosephate was added:	
To unfertilized plot	48
To cotton seed meal plot	204
To kainit plot	91
To cotton seed meal and kainit plot	54
Average increase with acid phosphate	99

Increase of seed cotton per acre when kainit was added:
To unfertilized plot 325
To cotton seed meal plot 506
To acid phosphate plot 368
To cotton seed meal and acid phosphate plot 356

Average increase with kainit 389

Fertilizer Experiments near Society Hill, Macon County.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	R. S. FLOYD 1906: Yield of seed cotton per acre	R. S. FLOYD 1906: Increase over unfertilized plot	R. S. FLOYD 1907: Yield of seed cotton per acre	R. S. FLOYD 1907: Increase over unfertilizee plot	A. B. FLOYD 1908: Yield of seed cotton per acre	A. B. FLOYD 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal ...	512	160	472	168	420	30
2	240	Acid phosphate	464	112	832	192	580	30
3	....	No fertilizer........	352	......	640	......	450	.....
4	200	Kainit	432	90	720	49	750	296
5	200 240	Cotton seed meal . Acid phosphate ..	552	220	1112	410	520	62
6	200 200	Cotton seed meal. Kainit	448	125	728	-4	610	148
7	240 200	Acid phosphate .. Kainit	424	111	856	94	550	84
8	....	No fertilizer........	304	......	792	......	470	.....
9	200 240 200	Cotton seed meal. Acid phosphate .. Kainit	616	312	1168	376	990	520
10	200 240 100	Cotton seed meal. Acid phosphate .. Kainit	554	280	1224	432	900	430

MACON COUNTY, 5 MILES SOUTH WEST OF SOCIETY HILL.
R. S. AND A. B. FLOYD, 1906–7–8.

Soil in 1907 *dark sandy loam*; *in* 1906 *and* 1908 *gray sandy soil*; *yellow subsoil in all experiments.*

All these tests were made on land that had been long in cultivation. The original growth is reported as probably short-leaf pine and hardwood.

On gray sandy soil in 1906 and again in 1908 the com-

plete fertilizer was by far the most effective and most profitable application. In both of these years rust was prevalent but least severe on the plots receiving kainia. On the other hand, in 1907, a year in which no rust troubled any plot, a mixture of cotton seed meal and phosphate on plot 5 gave the greatest increase, kainit being practically without effect.

In both years when rust prevailed, plot 10, receiving 200 pounds of kainit in its complete fertilizer, yielded more than plot 10, where only half as much kainit was used in the complete fertilizer.

	1906 Lbs.	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	328	716	460
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	160	—168	—30
To acid phosphate plot	108	218	32
To kainit plot	35	—53	—148
To acid phosphate and kainit plot	201	282	436
Average increase with cotton seed meal	126	70	73
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	112	192	30
To cotton seed meal plot	60	578	92
To kainit plot	21	45	—212
To cotton seed meal and kainit plot	187	380	372
Average increase with acid phosphate	95	299	71
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	90	49	296
To cotton seed meal plot	—35	164	178
To acid phosphate plot	—1	—98	54
To cotton seed meal and acid phosphate plot	92	—34	458
Average increase with kainit	37	20	247

Bullock County, 9 Miles East of Union Springs.
A. M. Cope, 1906. (See Table, p. 69.)

Gray sandy soil with porous yellow sandy subsoil.

The original growth of short-leaf pine had been cleared many years before. The stand of cotton was very uniform There was need of a complete fertilizer. Of the two complete fertilizers the one containing the larger amount of kainit per acre was more profitable. The need for nitrogen and for phosphate was somewhat greater than for potash.

The increase from the complete fertilizer on plot 9 was 760 pounds per acre, thus affording a net profit of $18.61 above the cost of fertilizer and above the cost of picking the increase. Indeed every fertilizer, whether used singly or in any combination whatsoever, gave a profitable increase.

	Lbs.
Average yield of seed cotton per acre, unfertilized	240
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	256
To acid phosphate plot	232
To kainit plot	240
To acid phosphate and kainit plot	400
Average increase with cotton seed meal	282
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	288
To cotton seed meal plot	264
To kainit plot	168
To cotton seed meal and kainit plot	328
Average increase with acid phosphate	262
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	192
To cotton seed meal plot	176
To acid phosphate plot	72
To cotton seed meal and acid phosphate plot	240
Avrerage increase with kainit	170

Fertilizer Experiments in Bullock, Barbour and Geneva Counties.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: Kind	Union Spgs A. M. Cope: Yield of seed cotton per acre	Union Spgs A. M. Cope: Increase over unfertilized plot	Louisville: Yield of seed cotton per acre	Louisville: Increase over unfertilized plot	Geneva: Yield of seed cotton per acre	Geneva: Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs
1	200	Cotton seed meal	496	256	304	104	736	268
2	240	Acid phosphate	528	288	272	72	640	192
3	....	No fertilizer	240	......	200	......	448	.....
4	200	Kainit	432	192	232	24	720	265
5	200 240	Cotton seed meal Acid phosphate	760	520	456	240	872	410
6	200 200	Cotton seed meal Kainit	672	432	472	248	720	252
7	240 200	Acid phosphate Kainit	600	360	312	80	624	150
8	....	No fertilizer	240	......	240	......	480	.....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1000	760	456	216	920	440
10	200 240 100	Cotton seed meal Acid phosphate Kainit	808	568	480	240	872	392

BARBOUR COUNTY, 3 MILES NORTH OF LOUISVILLE.
BY J. D. VEAL, 1905.

Gray, sandy soil, with stiffer gray subsoil.

This field had been long in cultivation.

The season was wet; rust was severe and all yields were small. Nitrogen afforded a larger increase than did phosphate or potash. The most profitable mixtures contained cotton seed meal, mixed either with acid phosphate or with kainit.

The year before, on the same or similar land, a complete fertilizer was the most profitable. Both years cotton seed meal and acid phosphate were needed.

In 1904 kainit was profitably used, giving an average increase of 100 pounds per acre, as compared with an average increase of only 38 pounds in 1905.

	Lbs.
Average yield of seed cotton per acre, unfertilized	220

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	104
To acid phosphate plot	168
To kainit plot	224
To acid phosphate and kainit plot	136
Average increase with cotton seed meal	158

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	72
To cotton seed meal plot	136
To kainit plot	56
To cotton seed meal and kainit plot	—32
Average increase with acid phosphate	58

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	24
To cotton seed meal plot	144
To acid phosphate plot	8
To cotton seed meal and acid phosphate plot	—24
Average increase with kainit	38

GENEVA COUNTY, 4 1–2 MILES NORTH OF GENEVA
M. P. METCALF, 1905.

Gray sandy pine land with stiffer red subsoil eight inches from surface.

The land had been in cultivation six years. Both cotton seed meal and acid phosphate were very effective, and a mixture of the two was the most profitable fertilizer. This year kainit was in most combinations useless.

In experiments on cotton made by Mr. Metcalf on similar land in preceding years the results indicated a need for phosphate; and in two of his experiments kainit was also very effective. Nitrogen was also needed except when supplied by a preceding crop of peanuts.

	Lbs.
Average yield of seed cotton per acre, unfertilized	464
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	288
To acid phosphate plot	218
To kainit plot	—13
To acid phosphate and kainit plot	290
Average increase with cotton seed meal	196
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	192
To cotton seed meal plot	122
To kainit plot	—115
To cotton seed meal and kainit plot	188
Average increase with acid phosphate	97
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	265
To cotton seed meal plot	—36
To acid phosphate plot	—42
To cotton seed meal and acid phosphate plot	30
Average increase with kainit	54

Henry County, 3 1-2 Miles North of Columbia.
Thos. Z. Atkeson, Columbia, 1908.

Light gray soil with yellow loamy subsoil.

The field had been cleared about 40 years, the principal growth having been long leaf pine. There was very little rain from the time the seed were planted, and cotton wilt and root knot further reduced the yield under these unfavorable conditions. All fertilizers increased the yield, but none to any large extent.

Yet the increase on plot 5 was sufficient to pay a fair profit over the cost of the fertilizer.

	Lbs.
Average yield of seed cotton per acre, unfertilized	94
Increase of seed cotton when cotton seed was added:	
To unfertilized plot	785
To acid phosphate plot	96
To kainit plot	254
To acid phosphate and kainit plot	148
Average increase with cotton seed meal	144
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	35
To cotton seed meal plot	54
To kainit plot	74
To cotton seed meal and kainit	32
Average increase with acid phosphate	48
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	33
To cotton seed meal plot	209
To acid phosphate plot	72
To cotton seed meal and acid phosphate plot	124
Average increase with kainit	109

Fertilizer Experiments in Henry County.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	COLUMBIA: Yield of seed cotton per acre	COLUMBIA: Increase over unfertilized plot	HEADLAND 1907: Yield of seed cotton per acre	HEADLAND 1907: Increase over unfertilized plot	HEADLAND 1908: Yield of seed cotton per acre	HEADLAND 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal ...	173	78	392	80	1015	130
2	240	Acid phosphate	130	35	208	104	1130	245
3	....	No fertilizer........	95	......	312	......	885	.....
4	200	Kainit	128	33	424	105	1020	150
5	200 240	Cotton seed meal . Acid phosphate ..	225	131	416	90	1245	390
6	200 200	Cotton seed meal. Kainit	380	287	656	324	1130	290
7	240 200	Acid phosphate .. Kainit	200	107	536	198	1170	345
8	....	No fertilizer........	93	......	344	......	810	.....
9	200 240 200	Cotton seed meal . Acid phosphate .. Kainit	3485	255	656	312	1425	615
10	200 240 100	Cotton seed meal . Acid phosphate .. Kainit	408	305	600	256	1410	600

HENRY COUNTY, 1 MILE EAST OF HEADLAND.
W. F. COVINGTON, 1907–8.

Gray sandy soil with yellow loam subsoil.

In 1907.—The experiment in 1907 was made on land that had been cleared about 40 years and was very poor, but otherwise representative.

The crop in 1906 was cotton fertilized with 500 to 600 pounds of a 9–3–3 guano. This probably explains in part why there was such poor response in 1907 to applications of phosphate. A further explanation is doubtless found in the observed fact that rust was worse on plot 2, fertilized with acid phosphate alone, than on other plots. Cotton seed meal and kainit both profitably increased the yield in whatever combination they were applied. The largest yield was made by a mixture of cotton seed meal and

kainit, on plot 6. Mr. Covington writes: "The kainit made good in every test, especially so on plots 4, 6, and 7. On these plots the leaves held longer and the bolls were larger and much better matured, this last being especially noticeable on plot 6."

In 1908. The field had been cleared about ten years. On this land, not so deficient in vegetable matter as that used the preceding year, a complete fertilizer gave the maximum yield and the maximum profit. Of the three constituents of the complete fertilizer, acid phosphate was most influential, closely followed by both of the others. It is notable that the complete fertilizer on plot 10, containing only 100 pounds of kainit, in addition to meal and phosphate, afforded almost as large a yield and a greater net profit than did the complete fertilizer on plot 9, which contained double this amount of kainit. The net profit due to 540 pounds of fertilizer on plot 10 was $14.27 (600 lbs. at 3.2 cents, less $4.93) per acre.

Apparently this soil needs a complete fertilizer and this conclusion is not shaken by the slight response to acid phosphate under the exceptional conditions of 1907, as stated above; this view is strengthened by the favorable results from complete fertilizers in earlier experiments on what seem to be similar soils in that part of the state.

	Lbs. 1907.	Lbs. 1908.
Average yield of seed cotton per acre, unfertilized	328	848
Increase in seed cotton when cotton seed meal was added:		
To unfertilized plot	80	130
To acid phosphate plot	194	145
To kainit plot	219	140
To acid phosphate and kainit plot	114	270
Average increase with cotton seed meal	152	172

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	—104	245
To cotton seed meal plot	10	260
To kainit plot	93	195
To cotton seed meal and kainit plot	—12	325
Average increase with acid phosphate	—3	256

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	105	150
To cotton seed meal plot	244	160
To acid phosphate plot	302	100
To cotton seed meal and acid phosphate plot	222	225
Average increase with kainit	218	159

Experiments at Betts, Conecuh County.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	BETTS 1905: Yield of seed cotton per acre	BETTS 1905: Increase over unfertilized plot	BETTS 1906: Yield of seed cotton per acre	BETTS 1906: Increase over unfertilized plot	BETTS 1907: Yield of seed cotton per acre	BETTS 1907: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*
1	200	Cotton seed meal...	784	216	1048	168	440	56
2	240	Acid phosphate	792	224	1064	184	424	40
3	....	No fertilizer........	568	......	880	......	384	.....
4	200	Kainit	704	139	920	37	392	9
5	200 240	Cotton seed meal . Acid phosphate ..	864	302	1080	193	456	74
6	200 200	Cotton seed meal. Kainit	832	273	1056	166	456	76
7	240 200	Acid phosphate .. Kainit	824	269	1040	147	440	62
8	....	No fertilizer........	552	......	896	......	376	.....
9	200 240 200	Cotton seed meal . Acid phosphate .. Kainit	896	344	1216	320	464	88
10	200 240 100	Cotton seed meal. Acid phosphate .. Kainit	880	328	1200	304	456	80

Conecuh County, 1–2 to 1 1–2 Miles North East of Betts.

R. H. Betts, 1905–6–7.

Gray sandy soil with red subsoil.

The land on which these tests were made had been cleared for 30 or 40 years. The original growth was reported hard-wood and short-leaf pine; if so, probably this soil is defferent from the average soil of the long-leaf pine belt.

In 1908 there was so much rain and such small yields that all fertilizers were about equally ineffective and unprofitable. In 1906 when both fertilized and unfertilized plots yielded well, complete fertilizer (on plots 9 and 10) afforded the largest net profit. In 1905 a mixture of cotton seed meal and acid phosphate was nearly as effective and quite as profitable as a complete fertilizer.

	1905 Lbs.	1906 Lbs.	1907 Lbs.
Average yield of seed cotton per acre, unfertilized	560	888	380
Average yield of seed cotton when cotton seed meal was added:			
To unfertilized plot	216	168	56
To acid phosphate plot	78	9	34
To kainit plot	134	130	67
To acid phosphate and kainit plot	75	173	26
Average increase with cotton seed meal	126	120	46
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	224	184	40
To cotton seed meal plot	86	25	18
To kainit plot	130	111	53
To cotton seed meal and kainit plot	71	154	12
Average increase with acid phosphate	127	119	3[illegible]
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	139	36	9
To cotton seed meal plot	57	—2	20
To acid phosphate plot	45	—37	22
To cotton seed meal and acid phosphate plot	42	127	14
Average increase with kainit	71	31	16

Inconclusive Tests.

The following inconclusive experiments were made:

Bullock County, O. M. Hill, Suspension, 1906.

Bullock County, F. B. Haynes, 7 miles South of Union Springs, 1908.

Chambers County, E. W. Smart, Fredonia, 1905.

Fayette County, J. B. Gibson, Newtonville, 1908.

Pickens County, D. W. Davis, Gordo, 1906.

The yields in these tests are given in the next table.

Inconclusive Experiments in Bullock, Chambers, Fayette, Montgomery and Pickens Counties.

Plot No.	Fertilizer: Amount per acre	Fertilizer: Kind	Suspension 1906: Yield of seed cotton per acre	Suspension 1906: Increase over unfertilized plot	Union Springs Haynes, '08: Yield of seed cotton per acre	Union Springs Haynes, '08: Increase over unfertilized plot	Fredonia 1905: Yield of seed cotton per acre	Fredonia 1905: Increase over unfertilized plot	Newtonville 1907: Yield of seed cotton per acre	Newtonville 1907: Increase over unfertilized plot	Newtonville 1908: Yield of seed cotton per acre	Newtonville 1908: Increase over unfertilized plot	Naftel 1905: Yield of seed cotton per acre	Naftel 1905: Increase over unfertilized plot	Gordo 1906: Yield of seed cotton per acre	Gordo 1906: Increase over unfertilized plot
	Sbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	808	16	450	150	816	728	1090	650	336	72	608	72	880	256
2	240	Acid phosphate	872	48	580	20	888	200	1080	640	408	144	488	48	752	128
3	....	No fertilizer	824	......	600	......	688	......	440	......	264	......	536	......	624	......
4	200	Kainit	856	37	740	180	912	152	1200	684	280	19	688	187	608	29
5	200 240	Cotton seed meal Acid phosphate	1088	274	570	50	768	64	1320	728	272	14	336	130	688	38
6	200 200	Cotton seed meal Kainit	984	175	630	150	192	288	1080	412	232	23	560	129	936	273
7	240 200	Acid phosphate Kainit	1000	195	540	100	1376	400	980	230	208	44	656	260	672	[illegible]4
8	....	No fertilizer	800	......	400	......	1048	......	820	......	248	......	360	......	688	......
9	200 240 200	Cotton seed meal Acid phospaate Kainit	960	160	450	50	1256	208	1380	560	256	8	664	304	824	136
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1224	424	390	10	1096	48	1340	520	232	16	712	352	848	160

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN.

FACING THE BOLL WEEVIL PROBLEM IN ALABAMA

BY
W. E. HINDS,
Entomologist

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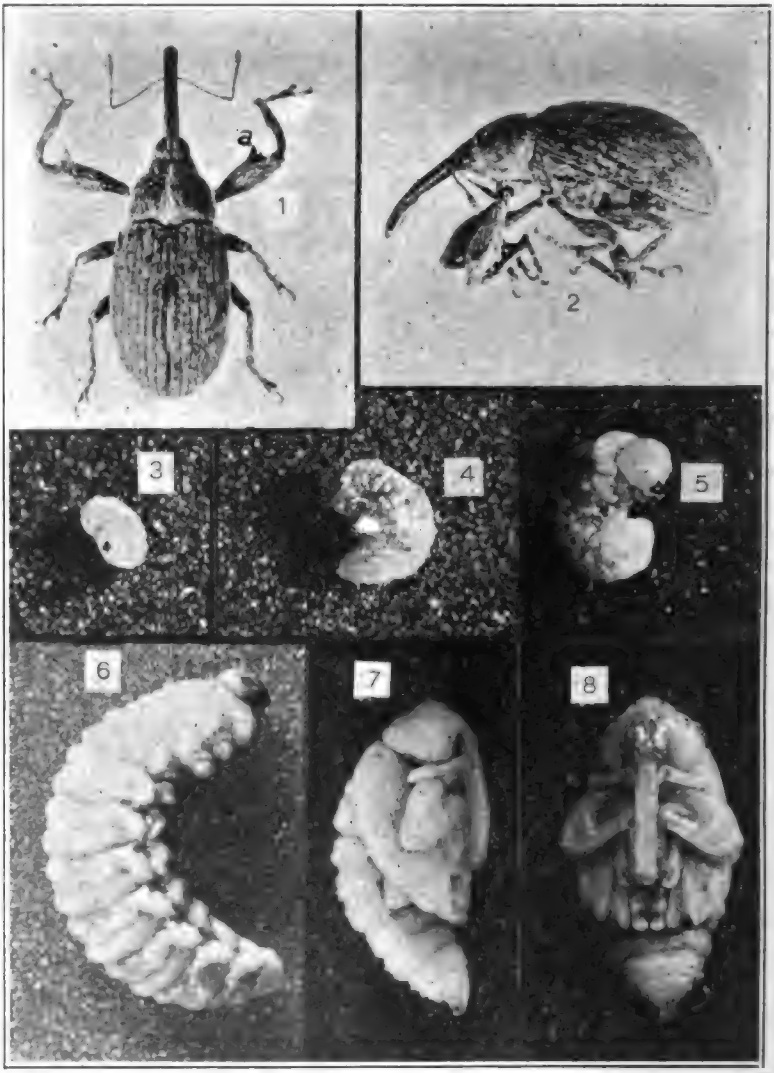
PLATE I.



THE BOLL WEEVIL AND ITS STAGES.

Fig. 1, Adult boll weevil, viewed from above; *a*, two teeth on fore femur; fig. 2, adult weevil, side view; fig. 3, egg of weevil; fig. 4, grub about two days old; fig. 5, grub at entrance to second stage after shedding first skin, about three days old; fig. 6, grub fully grown, about ten days from egg; fig. 7, transformation or pupal stage, side view, snout, legs and wings forming; fig. 8, pupal stage, front view of fig. 7. Figs. 1, 2, 6, 7 and 8 enlarged about ten diameters; figs. 3, 4 and 5 enlarged about twenty diameters. (Original).

FACING THE BOLL WEEVIL PROBLEM IN ALABAMA

INTRODUCTION.

That within three years the Mexican cotton boll weevil will have entered Alabama is as certain as it is that cotton will continue to be produced in this and adjoining states before that time. The certainty that the cotton planters of Alabama will soon have to contend with an enemy more difficult to fight and more destructive to the crop than anything which they have ever been forced to face should be a matter of deep and immediate interest to every citizen of the state regardless of his occupation. If we shall meet this grave problem in a manner to result in a minimum of loss to all branches of commercial and professional as wel as of agricultural life, it is essential that we improve to th utmost the few years which may intervene in direct an united preparation for the great changes in agricultural practice and in economic conditions generally which the presence of this pest has invariably caused wherever it has gone. We may well be willing to profit by the experience for which our sister States of Texas, Louisiana and Mississippi, particularly have paid so large a price. We should by all means begin immediately to put into active operation some of the fundamental improvements in agricultural practice which have been worked out during the past few years as a direct result of the fight against the weevil. If these practices are advisable and profitable anywhere with the boll weevil present they may be made even more so here and now before the weevil arrives. The great opportunity for gaining experience and determining the immediate applicability of any of these practices to our local conditions is evidently the period before the weevil comes and while we do not have to suffer the losses which it is very certain to inflict wherever it exists.

It may be pardonable in this case to mention a few per-

sonal facts which may enable the reader to judge of the writer's competency in this subject. From July 1, 1902, until September 30, 1907, he was engaged constantly and exclusively under the U. S. Bureau of Entomology in the investigation of the Mexican cotton boll weevil in Texas. The seasons of 1902, 1903 and 1904 were spent principally in South Texas where the weevil had been abundant for several years and where it was doing great damage. The seasons of 1905, 1906 and 1907 were spent in north Texas, in a region which was then but recently infested. In this work he was associated with Mr. W. D. Hunter who has been in direct charge of the boll weevil investigation from 1901 to the present time. The most important of the boll weevil publications are referred to in the Bibliography, see page 100.

Within the limits of this brief paper it is impossible to touch upon many of the important and interesting points in the discovery, introduction, life history and control of this insect.

It spread into the Southern part of Texas from Mexico about 1892 and from that time to this nothing has occurred to more than temporarily check its annual advance into new cotton growing country. Its annual spread is mainly by flight and cannot be prevented by human effort. The best that can be done is to guard against assisting in the spread of the pest and to do everything possible to avoid and to minimize the injury which its very presence involves. As soon as the weevil entered Texas it became apparent that the investigation of methods for its control constituted a National, rather than a State problem. Since 1901 Congress has been making special appropriations for the investigation of the boll weevil and from one to twenty trained men have been giving their time constantly to the study of this most serious problem. The writer was personally engaged in this work for more than five years. Naturally the damage which it has done has increased from year to year with the increase in the area infested. It is safe to say that the loss which it now occasions cannot be less than $25,000,000 each year.

The National government has spent more than $1,000,000 in the investigations which have been made to discover effective methods of controlling the pest, and the various states affected have also expended large sums. The information and recommendations given in the following pages are gathered from the best that has been learned in this great struggle. A few of the important publications concerning the weevil are referred to in the Bibliography on page 100.

Since 1892 the weevil has spread Northward through Texas and the Southern half of Oklahoma and Eastward, crossing Louisiana, the Mississippi River and into Mississippi. From the infested territory each year it spreads ever onward as wave after wave spreads outward when a stone is cast into water. The old territory is not abandoned since only part of the host of weevils which is developed by fall will leave the field to seek new territory. Undoubtedly many fly back into previously infested fields where their presence is lost sight of but those which happen to fly in to new localities quickly establish a new line of infestation which can be quite readily marked.

The distance through which they have thus advanced has averaged fully fifty miles each year. The first weevils crossed the Mississippi River in the fall of 1907 and during the fall of 1908 eighteen counties in the western part of that State became either wholly or partially infested. The area now infested constitutes more than one third of the cotton growing area of the United States and produces nearly one-half of the annual crop. The limits of the infestation, the relationship which this bears to the entire commercial cotton growing area, and the annual progress of the pest during recent years are plainly shown upon the accompanying map, Fig. 1, which was prepared by Mr. W. D. Hunter during the fall of 1908 from data collected by the numerous field agents of the Bureau of Entomology investigating the spread of the boll weevil.

Fig. 1. The cotton growing area showing the area infested by the boll weevil during various years. (After Hunter, Farmers' Bul. 344.)

WHEN WILL THE WEEVIL REACH ALABAMA?

A brief study of this map with the facts stated relating thereto should be enough to convince anyone that the advance of the boll weevil will most certainly continue. The present northern limit of infestation is farther North geographically than is any portion of Mississippi, Alabama, or Georgia. The existence of the boll weevil depends primarily upon the occurrence of cotton which is its only known food plant. Besides its dependence upon this food supply the continued existence of the weevil depends also upon its ability to survive the winter climatic conditions in order to pass from the crop of one season to that of the next. The weevil has already shown that it can withstand successfully temperatures reaching nearly if not quite to Zero F. which is as low as is likely to occur anywhere in the cotton belt.

The eastward spread of the weevil therefore promises to be as certain and as rapid as was its northward spread through Texas and Oklahoma until ultimately it shall infest cotton wherever grown commercially in the Southeastern States. Its spread may be accomplished in two general ways.

In the first place the weevil will continue to spread by its own unaided flight which man is powerless to prevent. The entire area embraced within a line passing through the outermost points thus reached each year must be considered as constituting the "area of general infestation" although the weevil may not occur at many of the places included within but near the outermost edge of this area. The line referred to is "the line of general infestation" and this is what we reckon with in the annual spread of the boll weevil. It may be shown that this line has been steadily advanced through an average distance of about fifty miles each year. We may expect this rate to be maintained as the weevil continues eastward to the Atlantic Coast. From this basis we may easily and quite certainly determine that in two seasons more, that is by November 1910, we may expect the line of general infestation to reach the Mississippi–Alabama boundary. It is quite likely that some of the western tier of

counties in this State may then become partially infested. It will require only about three years more for the weevil to spread over the entire State and to reach Western Georgia. Therefore we may consider it practically certain that throughout the western third of Alabama by the summer of 1911, through the central third by 1912, and through the eastern third by 1913, and in each case constantly after those dates, every cotton planter will have to reckon with the presence of the boll weevil and some degree of injury by it.

In the second place, we must consider that the boll weevil is *liable* to be brought into the State at any time ahead of the general infestation by the various methods of transportation, principally by railroads, with persons, household goods, cotton and its products, or with any other articles which may contain or shelter them. This danger naturally increases as the line of infestation approaches more closely In numerous instances in Texas, Louisiana, Mississippi and elsewhere it has been clearly established that the weevil has been carried long distances in shipments of cotton seed from infested areas although fortunately it has not yet happened in the direction of uninfested territory. Infested cotton produced in the edge of the infested area has been hauled considerable distances beyond for ginning and planters bringing their cotton from other directions have carried away weevil-infested seed with them. Tenants and cotton pickers moving from infested to uninfested territory are very liable to carry weevils with them and thus establish new centers of infestation. These are among the considerations which have made necessary the establishment and strict enforcement of quarantine measures to guard against the accidental introduction of the weevil.

QUARANTINE REGULATIONS AGAINST THE BOLL WEEVIL.

Alabama passed such a law in 1903, and placed the enforcement of the act in the hands of the State Board of Horticulture, as at that time there was no special Ento-

mologist connected with the State Experiment Station.

Text of Alabama Boll Weevil Law.

An Act to prevent and prohibit the importation of seed from cotton affected with the Texas boll weevil.

Section 1. Be it enacted by the legislature of Alabama, That no person shall import or bring into the State of Alabama any seed from cotton affected with what is known as the Texas boll weevil, nor the seed from any cotton from any place where the cotton has been affected with said boll weevil.

Sec. 2. Any person who violates the provisions of section 1 of this Act shall be guilty of a misdemeanor, and on conviction shall be fined not less than ten dollars ($10.00) and not more than five hundred dollars ($500.00).

(H. 877, No. 559, approved Oct. 6, 1903.)

In addition to the above, the State Board of Horticulture organized by Act of the Legislature No. 121, approved March 5, 1903, has established regulations governing the shipment into and through the State of cotton products, packing materials, household goods, etc. The text of the regulations which are at present in force is as follows:

RULES AND REGULATIONS

Governing the Importation of Articles Liable to Contain the Mexican Cotton Boll Weevil.

Rule 11. In accordance with an act of the Legislature of the State of Alabama entitled: An act to Further Protect Horticulture, Fruit Growing and Truck Gardening, and to Exclude Crop Pests of all kinds in the State of Alabama, approved March 5, 1903; the following rules and regulations relative to the Mexican Cotton Boll Weevil were adopted:

(a) That in order to prevent the introduction of the Mexican Cotton Boll Weevil into the State of Alabama, a rigid quarantine is hereby declared against all infested localities in Texas or Louisiana, and of other sections that are or may hereafter become infested.

(b) That cotton lint (loose, baled flat or compressed) cotton seed, seed cotton, hulls, seed cotton and cotton seed sacks (which have been used) and corn in the shuck, originating in cotton boll weevil infested localities, shall be excluded absolutely from the State of Alabama.

(c) All shipments of household goods from infested areas shall be prohibited unless the same is accompanied by an affidavit, attached to the way-bill stating that the shipment contains no cotton

lint, cotton seed, seed cotton, hulls, seed cotton and cotton seed sacks or corn in the shuck.

(d) All shipments of quarantined articles, mentioned in section (b) above, through the State of Alabama shall be made in tight, closed cars.

(e) No common carrier shall use for bedding, or feed for live stock, any of the quarantined articles when the shipments originate in regions infested with the cotton boll weevil.

(f) All railroads, steamboats, express companies and other common cariers, and all private vehicles, boats, etc., entering the State of Alabama from the states of Texas or Louisiana, or passing through the State of Alabama from any of the infested districts of the States of Texas or Louisiana, are especially enjoined to comply with the requirements of this order and of laws of the State of Alabama governing the same.

RULE 12. The State Horticulturist is hereby charged with the enforcement of the rules and regulations relative to the Mexican boll weevil.

The form of affidavit accompanying the waybill with shipments of household goods should specify the prohibited articles as not included, as follows:

State of...................., County of ....

Before me ....Notary Public in and for said State and County, personally appeared .... who being duly sworn states on oath that the shipment of .... waybill of which this affidavit accompanies, does not contain any cotton lint, cotton seed, hulls, seed cotton and cotton seed sacks or corn in shuck.

Sworn to and subscribed before me this......day of .... 190..

(Seal) .... Notary Public.

At the bottom of all law lies the general consideration that the safety and welfare of the public is more important than the convenience or interest of any private individual. It is certainly of public advantage that every possible precaution be taken to prevent needlessly hastening the spread of so dangerous an insect pest as this. The advance of the weevil will gradually transfer states, counties, and localities from the uninfested to the infested territory and thus reduce the area in which quarantine measures apply. Within five years, therefore, the boll weevil quarantine may become a thing of the past in this State. In the meantime it

is of highest importance that we be able to definitely establish the limits of infestation and determine just where the application of the quarantine will do good instead of harm. Obviously no restriction of personal or commercial movement is justifiable or desirable if no protection or benefit may result. We therefore urge upon all concerns or individuals to whom the provisions of this quarantine may apply that they continue to give it their cheerful and complete support so long as may be necessary. More detailed information will be furnished all who may request it upon any specific points by the "Entomologist to the Experiment Station, Auburn, Ala."

DESCRIPTION OF THE BOLL WEEVIL.

It is of extreme importance that we learn of the presence of the weevil anywhere in the state as quickly as possible after its arrival. For information on this point we must necessarily depend principally upon the reports of cotton planters and others directly interested in this subject. As a rule we cannot depend for this information upon newspaper reports, even when these are vouched for by some planter who "came from the boll weevil country". With the boll weevil, as with most other insects, the ordinary casual observer fails to notice any but the most obvious characters on account of their small size. Therefore the characters noted are more than likely to be only those which are common to a group including hundreds of closely related species rather than those distinctive of a single species. By careful attention to the following brief description and to the illustrations given herewith we believe that the reader of average intelligence may be able to distinguish the boll weevil from the numerous other insects occurring on cotton, which are often mistaken for it (see appendix) and to recognize its attack on the plant with a reasonable degree of certainty. In any case of doubt specimens should be sent immediately in a strong, tight, tin or wooden box, with a letter of explanation to the Entomologist, Alabama Experiment Station, Auburn, Ala. He will gladly determine

such specimens and report to the sender entirely free of cost.

The boll weevil is a beetle belonging to a large group, all of which are characterized by having part of the head in front of the eyes greatly extended to form a long slender snout. There are many hundreds of species of these insects, all of which are commonly called "weevils", but the Mexican cotton boll weevil is the only one of these many species which is at all serious as an enemy of cotton. While other species may be found upon cotton plants, their occurrence there is mainly accidental. Rarely indeed does any other species breed upon cotton. The boll weevil breeds upon cotton and upon nothing else. Like all other beetles the boll weevil has four distinct stages in the development of each individual. These are the egg (Pl. I, fig. 3), which is only about 1-30 of an inch long, white and delicate. This is always deposited in a cavity which the female eats in the square or boll and upon no other part of the plant. From the egg there hatches in a few days a white, legless grub or worm (Pl. I, figs. 3–6) which does not at all resemble the beetle which it may finally become. The grub of the boll weevil resembles very closely that of the "plum curculio" which is so familiar a pest in peaches, plums, cherries, etc., working in the fruit and usually around the stone. The boll weevil grub grows steadily from its initial length of about 1–25 of an inch until it becomes fully grown and measures from 1–5 to 2–5 of an inch in length. The body is strongly curved in the form of a crescent, in this respect being more curved than the "worm" in peaches, etc. (Pl. I, fig. 6.)

In order to attain the beetle form the grub must pass through an intermediate "transformation stage" which is known as the "pupa." (Pl. I, figs. 7 and 8.) In this stage no food is taken, and there is a complete change of the appearance and of structure. The grub sheds its skin and instead of the legless, wingless, snoutless worm, the pupa appears with all of these organs forming in sheaths closely applied to the body. In this stage the insect is very delicate,

and perfectly helpless. It, as well as the egg and grub stages, is passed wholly within the interior of the square or boll. These three constitute the immature stages in the life of the weevil, but are as characteristic of the insect as is the adult form.

After a few days the pupa sheds its skin and becomes the fully formed adult weevil as shown in Pl. I, figs. 1 and 2, having the legs and snout free and usable, as are also the wings, which are folded back, under and protected and hidden by, the hard wing-covers, which meet in a straight line over the middle of the back of the beetle. For a few days the adult also remains protected within the square or boll while it becomes hardened and more able to care for itself. It then cuts a circular hole just the size of its body in the wall of its cell in the square, and through this opening makes its escape into the outer world, where from that time on it leads a free and active life.

The adult weevil, therefore, is the form most commonly seen around infested cotton, and this stage needs a more detailed description. The full grown weevils vary considerably in size and in color. In length they range between 1-8 and 3-8 of an inch, while the breadth of the body is approximately 1-3 of its length. The general color is uniform over the body and varies from a chocolate brown in the darkest specimens, which are usually below average size, to a grayish or yellowish brown in the lighter colored larger forms. The lighter colors are due to light colored scales or modified hairs which occur most abundantly in the larger specimens. If these are undeveloped or become rubbed off, then the dark brown ground color of the weevil appears. The slender snout is only slightly curved and is about 1-2 as long as the length from the head to the tip of the body. Neither the size, nor the structure or general appearance of the weevil changes at all after its emergence from the square or boll in its adult form. The adults feed and mate and the females then deposit eggs. This completes the "Life Cycle" and starts another generation all within a period of from three to four weeks.

THE EFFECT OF WEEVIL WORK ON COTTON.

The recognition of the presence of the boll weevil may depend upon the identification of the adults or the immature stages in squares and bolls or just as certainly upon the recognition of its feeding injuries or the effect of its work upon the fruiting of the cotton, as these are also characteristic. No other insect produces at all similar injuries to cotton.

The excrement deposited by the adult weevils on the squares upon which they work is of a bright orange color and so forms a conspicuous sign of boll weevil presence. The egg punctures, like those made for feeding, are eaten out but are only made large enough to receive the egg which is placed just inside of the floral coverings and usually near the base of the bud. The natural tendency of the green parts of plants to heal wounds in which decay does not occur causes a growth of plant cells to more than fill the canal leading to the egg cavity. The excess of this growth bulges outward so that it forms a distinct "wart". This "wart" is therefore characteristic of a boll weevil egg puncture. As the grub feeds and grows inside the bud it destroys the very heart of the square, until when about half grown its injury thereto becomes so great as to cause the destruction of that bud. The leaflets enclosing the bud spread apart, or "flare" as it is called, and the whole square turns yellow, wilts and is shed as are leaves when they can be of no further use to the plant. It is Nature's surgery in removing a diseased and useless member. Upon the ground the development of the grub continues and its transformation through the pupal stage to the adult beetle takes place. Practically one-half of the developmental period is spent in the square on the plant and the other half in the square after it has fallen to the ground. Badly infested cotton produces few, if any, blooms, while the infested squares shed by the plant as fast as they form are thickly scattered beneath it on the ground. Squares may be shed as a result of adverse cultural or climatic influences, but

when shed from such causes they show no signs of weevil or other insect injury such as have been described.

RECOGNITION OF THE WEEVIL.

We may summarize briefly the most important characteristics upon which we may depend for the prompt recognition of the weevils' presence in Alabama:

1. The adult beetles (Pl. I, figs. 1 and 2) probably found on cotton only, are about 1–4 inch long, with slender, slightly curved snouts, of dark brown, ashy-gray, or yellowish brown color.

2. The crescentic grubs (Pl. I, fig. 6) about 3–8 inch long and the pupal stages (Pl. I, figs. 7 and 8) occur only in squares and in bolls. This is the only insect which breeds in this way in cotton.

3. The occurrence of open cavities 1–16 to 1–20 inch in diameter and reaching down to larger excavations among the pollen sacs, the presence of "warts" marking the egg punctures of the weevil, the occurrence of the orange-colored excrement on the buds, the abundant shedding of squares and the consequent scarcity of blooms without accompanying rain or cultural conditions to cause the shedding; these are among the most conspicuous signs of boll weevil presence and injury.

Whenever any specimens of weevil or cotton squares or bolls showing weevil stages or the signs of their work are discovered anywhere in Alabama in advance of the general infestation by the weevil, it is of the utmost importance that they be immediately submitted to the Entomologist, Auburn, for positive identification. We must depend upon the hearty co-operation of cotton planters in this work, as upon the promptness with which the first occurrence of the weevil in a locality is discovered and reported to the Entomologist

depends entirely the possibility or advisability of undertaking any measures for the extermination of the weevil which might prevent the infliction of damage to that locality for several years before it would necessarily occur through coming within the area of general infestation.

Undoubtedly during the next few years local newspapers, as well as the leading papers of the State, will frequently receive reports of the occurrence of the boll weevil in their vicinity. Editors, before publishing such items, should secure specimens and forward them to the Entomologist and await his report as to their genuineness. Published statements, if untrue, can only do harm among their readers, and for a time the harm will be as great as though they were true, as they will affect all agricultural and business interests. This is too serious a matter to permit of the creation of undue excitement through the circulation of misleading impressions. The situation should be faced calmly, intelligently and courageously to safeguard the best interests of all who may be affected by whatever effects the production and sale of cotton. If faced in this spirit there is absolutely no need for the existence in Alabama of the feeling of "panic" which has heretofore accompanied the weevil during the first few years of its occupation of new territory.

HOW THE BOLL WEEVIL MAY BE SUCCESSFULLY CONTROLLED.

The great difficulty in fighting the boll weevil has arisen from the fact that the peculiar habits of the adult and the protection of the immature stages within the squares and bolls render it practically useless to attempt to destroy them by any usual methods of insecticidal treatment. Hundreds of remedies have been tested and found ineffective for the above reasons, if for no others. As in human warfare, one of the most effective measures of subduing an enemy consists in destroying their food supplies, so it is equally true in the case of an insect which is dependent upon one species of food plant as is the boll weevil. That the weevil can be effectively controlled and the culture of cotton continued at fully as great profit as has usually been realized without the weevil, has been proven possible through the practical application in many thousands of cases in the weevil area of improved methods in cotton culture and in general agricultural practice. Some of these measures take advantage of and increase the effectiveness of certain factors of natural control. Most of them, however, are merely **steps in a system of cotton culture** which prepare the way for the application of the **one most effective direct method of destroying immense numbers of weevils by cutting off their food supply at the only season of the year when the destruction of cotton is possible, practicable and most effective in reducing the number of weevils. The final step is the complete destruction of all green cotton at least three or four weeks before the usual date for the occurence of the first killing frost in the fall.** This has often been called the most important single step in the cultural system of controlling the boll weevil. It may seem to many that it cannot be successfully applied under the conditions existing in Alabama. That has been claimed

also in Texas, Louisiana and elsewhere, but it has been found always that **it is possible under almost all conditions if the necessary steps leading up to it are also employed.**

We must remember that the presence of the boll weevil inevitably produces a change in the conditions of cotton growth. Practically, there can never be "late cotton" in the infested area. The only portion of the crop to escape the weevils and mature is that which develops early in the season before the weevils have reached their maximum abundance. Therefore the very presence of the weevil tends to limit cotton production to the early crop and to clear the way for the proposed and necessary destruction of the stalks.

The effectiveness of this practice has been most positively established by the repeated experience of planters on large as well as upon small scales, and also through Nature's object lessons whenever through the effects of unusual climatic conditions or when by the defoliation of the plants by the cotton leaf caterpillar or cotton worm there has resulted the practically complete destruction of cotton at an unusually early date in the fall. In every such case the fall destruction has been followed by larger crops, less weevil injury and a great increase of net profit in the crop of the following year.

We have not room in this paper to give details regarding any of these great demonstrations, but can merely state that in many cases where the work has been conducted most carefully with adequate checks **the value of the increase in the crop on the area where stalks were destroyed has been from $15.00 to $20.00 per acre, as compared with the yield on the check areas on which the stalks were allowed to stand until the usual time of preparation for planting in the spring. In all other respects both areas received similar treatment and were grown under like conditions.**

STEPS IN THE CULTURE OF COTTON FOR CONTROLLING THE BOLL WEEVIL.

The immediate adoption of such improved agricultural practices, as rotation and diversification of crops, better culture and more careful selection of seed for cotton **as soon as the weevil is known to be within less than 100 miles of any locality.**

In order to practice early destruction of stalks it is essential that part, at least, of the other steps be also adopted as they are of prime importance in leading up to the early maturity of the crop. It is impossible for us here to attempt to describe these steps at all fully. Much more can be learned regarding them from a study of the publications referred to in the brief Bibliography on page 100.

If we begin this work for the control of the weevil in the fall, as is desirable for securing its greatest effectiveness, it may involve the sacrifice of a small amount of cotton from the late maturing bolls. It is not necessary to make this sacrifice until the first year that the weevil is likely to reach the locality. After that time the possible loss of a few pounds of "scrappings" should not be allowed to count as against the necessity for and larger benefits of early destruction.

DESTRUCTION OF STALKS.—The best method of destroying the stalks is by uprooting and burning them. The roots, if cut, should be cut below the surface to prevent their putting out sprouts later. The plants should be thrown into windrows or piles while still green so that the leaves, squares and bolls may not be scattered but will remain on to assist in the early burning of the stalks and also because it is desired to destroy immediately the immature stages which may be present. Sometimes it will be found worth while to apply crude oil to faciliate the burning before the stalks have time to fully dry.

ADVANTAGES OF EARLY BURNING.—1. It stops absolutely the development of weevils late in the fall by destroying the immature stages then present in squares and bolls. 2. By

the complete removal of their only food it forces the dispersion and starvation of the weevils already adult. Obviously the longer the period between the destruction of all green cotton and the occurrence of the first killing frosts, at which time the weevils may go into winter quarters with most assurance of survival, the more complete will be the destruction of the adults. 3. It removes a large amount of rubbish within which those weevils which escape destruction would find the most favorable conditions for their successful hibernation. 4. It prevents the development of adults emerging shortly before frost. These are the weevils which ordinarily stand the best chance of living through the winter. Where one weevil may live through the winter if stalks are destroyed by the 15th to the 20th of October, there will be at least ten survivors if the destruction of stalks is delayed until the middle of November. There is a constant increase in the percentage of survival between these dates.

Preparation of the Land for Cotton.—This should be more thorough than is usually given. On light soils fertilizers are needed for cotton, and those containing a relatively large percentage of phosphoric acid tend to promote the early maturity of the crop.

Planting.—Let this be done as soon as danger of frosts is passed. Early planted cotton invariably does better than even medium planted where the weevil occurs. It is desirable that the planting in a locality should be done as near the same date as possible, so that all of the cotton will be coming on together. The weevils thus have no chance to get a start upon any of the fields. Plant the rows at such distance apart as has been found to give best yields in any field.

Chopping.—Chop to a stand early, as this gives the plants that are left a better start. Space the plants as has been found best for yield in any field.

Cultivation.—This should be frequent and shallow. Its first object is to keep the soil in favorable condition for producing a steady and rapid growth of the crop. The destruction of weeds is accomplished incidentally. The surface

crust that may form after rains should be broken up as soon as possible.

Harvesting.—Let this be done as quickly as the bulk of the crop is open. Every effort should be made to have ready the necessary labor supply for this work as soon as it may be done. Remember always the need for keeping a winter cover crop on the soil and for clearing the way for the early destruction of the stalks. The earlier these may be destroyed the better. **Their destruction constitutes the last step in dealing with the cotton crop each year where the boll weevil is present and is also the first step in preparation for the next crop of cotton, even though the cotton may occupy some other field through the system of rotation.**

CONCLUSION.

We hope that we have made plain that the coming of the boll weevil is assured, and that we shall very soon have to reckon with it constantly in the culture of cotton. We hope also that what we have said may help the cotton planters of the State to face this serious question more intelligently and more courageously than they would otherwise have done. In spite of the admittedly serious nature of the weevil as an enemy of cotton, there is no need for a "feeling of panic" if the recommendations given herewith are put into practice immediately. Their general application will improve the conditions of farm life, increase the value of farm property and multiply profits to both owners and tenants. In most sections where the weevil has already gone there have been heavy losses during the first two or three years of infestation because planters have been slow in adopting just the changes in cotton culture which have been outlined herein. They have thought at first that they were perfectly familiar with the best methods of raising cotton, and that no "scientists" could tell them anything about it. As a result, they have been finally forced to give up cotton altogether, or to adopt part, at least, of the methods which

have been described. With the adoption of the improved practices the control of the boll weevil has ceased to be an exceptionally serious problem, and they have found that in this way it is entirely possible to raise as much, or even more, cotton per acre as they were accustomed to raise before the coming of the weevil. The diversifying of crops has helped to make the farmers of the boll weevil area more independent of cotton as a single crop, and in many sections they are now more prosperous than ever before. In many respects the advent of this pest has resulted in greater final benefits than its injuries, and there has been brought about within five years a greater agricultural development than would have been likely to have come in two or more times as long but for the coming of the weevil.

If it shall lead to the immediate application of many of the improvements herein recommended, then the coming of the boll weevil shall bring a blessing and not a curse to this State. May every agency be united in a helpful co-operative campaign of progressive education that shall prepare us to best meet and to most effectively overcome the boll weevil in Alabama.

BIBLIOGRAPHY.

This is intended to be only a very partial list of the publications relating to the boll weevil, but to include those available which may be most useful to the planters of Alabama.

Publications of United States Department of Agriculture, Bureau of Entomology, Washington, D. C.

Bulletin No. 51. The Mexican Cotton Boll Weevil. Hunter & Hinds. 181 pp. Published 1905. (Write your Congressman for a free copy.)

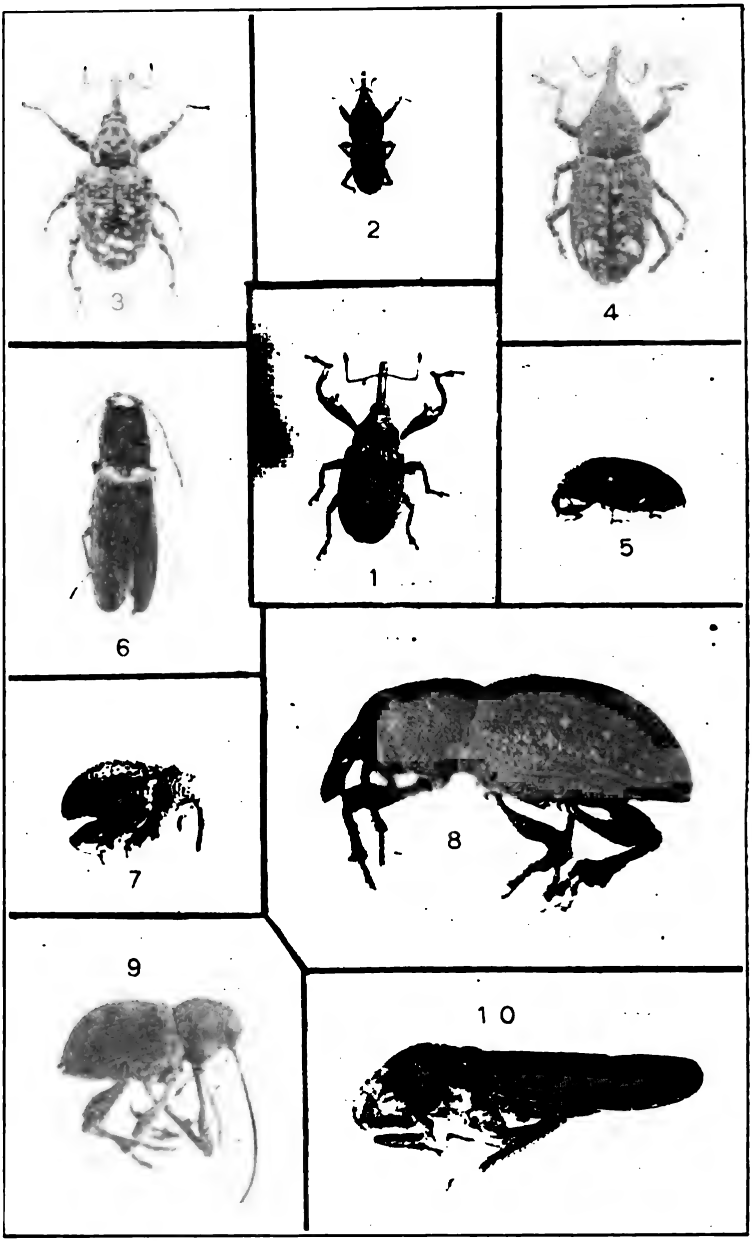
Bulletin No. 74. Some Factors in the Natural Control of the Mexican Cotton Boll Weevil. Hinds. 79 pp. Published 1907.

Farmers' Bulletins Nos. 47, 130, 163, 189, 209, 211, 216, 217, 223, and 344.

(All of the above relate to cotton insects, the boll weevil or to cotton culture, and may be obtained free upon request to the Department.)

Publications of Louisiana Crop Pest Commission, Baton Rouge, La. Circulars 8 and 23.

PLATE II.



INSECTS OFTEN MISTAKEN FOR THE BOLL WEEVIL.

Fig. 1, Boll weevil (*Anthonomus grandis Boh.*); fig. 2, rice weevil which breeds abundantly in corn (*Calandra oryzae* Linn.); fig. 3, plum curculio (*Conotrachelus nenuphar* Hbst.); fig. 4, white pine weevil (*Pissodes strobi* Peck.); fig. 5, transverse Baris (*Baris transversa* Say); fig. 6, a click beetle (*Monocrepidius vespertinus* Fab.); fig. 7, cow pea pod weevil (*Chalcodermus aeneus* Boh.); fig. 8, Pales weevil (*Hylobius pales* Hbst.); fig. 9, an acorn weevil (*Balaninus* sp.); fig. 10, sharpshooter (*Homalodisca triquetra* Fab.). All enlarged about five diameters. (Original.)

APPENDIX

The Mexican Cotton Boll Weevil and Some of the Insects Most Frequently Mistaken for it.

For the sake of facilitating comparisons a figure of the boll weevil is included on Plate II. Fig. 1. All figures have been taken at the same magnification of approximately four diameters.

In this list the "rice weevil," (*Calandra oryzae* Linn), Pl. II, fig. 2, has been included not so much because it has been, or may be, mistaken for the boll weevil, as because its size and general appearance may be more familiar to the general reader than any of the other species mentioned. A comparison of the adult insect with the illustration may aid in conveying a more correct conception of the other less familiar species. This weevil breeds very abundantly in corn, but does not injure cotton.

The "plum curculio", (*Conotrachelus nenuphar* Hbst.), Pl. II, fig. 3, which attacks peaches, plums, etc., very commonly, is about the size of the boll weevil but is much darker in color with markings of white or light colored scales on its back and legs. It has a shorter, more strongly curved snout and but a single tooth upon the thigh of the fore legs. It never attacks cotton.

The "white pine weevil", (*Pissodes strobi* Peck.), Pl. II, fig. 4, occurs in Alabama and must attack also some southern species of pine. The body is longer and more cylindrical, while the snout is relatively much shorter than in the boll weevil. Its wing-covers bear each a prominent white spot toward their tips.

The "pales weevil", (*Hylobius pales* Hbst.) Pl. II, fig. 8, is another species which attacks pine. It is a large species, being from 1-3 to 1-2 inch long. Its color is a dark brown with small spots of light colored scales scattered over the wing-covers. This species is very common in Alabama.

The "cow-pea pod weevil," (*Chalcodermus aeneus* Boh.), Pl. II, fig. 7, is often taken on cotton following a crop of cow peas in the same field or near vicinity. It is the only one of the species mentioned herewith which may do some

slight damage to cotton. It sometimes feeds on the young cotton plants, boring into the main stems or leaf stems and causing the death of leaves and tips, but there is only one record of its having bred in a cotton square. The adults are shining black in color, somewhat shorter and more stoutly built than is the boll weevil, and the back of the body shows numerous small, circular pits arranged in several rows along the wing-covers.

The "transverse Baris", (*Baris tarnsversa* Say), Pl. II, fig. 5, is a small, black weevil much shorter, broader proportionately and flatter than the boll weevil. Its snout is very short and strongly curved. This species breeds in the roots of cocklebur, and the adults occur accidentally upon cotton as may another closely related and similar appearing species that breeds in the roots of ragweed.

There are several species of "acorn weevils" belonging to the genus Balaninus. One of these is shown in Pl. II, fig. 9. All have very long, slender snouts, sometimes even longer than the body. All breed in acorns, and are often attracted to lights, as the boll weevil never is.

Some of the "click beetles" have a habit of hiding during the day in cotton squares, and are therefore mistaken for the boll weevil, although they do not resemble it in the least. One of these (*Monocrepidius vespertinus,* Fab.), Pl. II, fig. 6, is most commonly mistaken. In its early stages it lives on the roots of grasses in the cotton field, and the adult hides around the plant, but it does not attack cotton at all. These are all long, slender, flat-bodied beetles which, if turned over on their backs, will spring into the air with a "click" and thus regain their footing.

The last species that we have space to mention here is a bug belonging to a group of insects known as "leaf hoppers". These insects have the habit of sucking sap from the stems of plants and may occur on cotton where they have sometimes been called "sharp-shooters". These are grotesque insects which do not resemble the boll weevil at all. One species, (*Homoladisca triquetra* Fab.), is shown in Pl. II, fig. 10.